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RFI Work Plan for Operable Unit 1085

Environmental Restoration Program

May 1994

A Department of Energy
Environmental Cleanup Program

FINAL DRAFT

Los Alamos
NATIONAL LABORATORY

LA-UR-94-1033

EXECUTIVE SUMMARY

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Purpose

The primary purpose of this Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) work plan is to determine if Potential Contaminants of Concern (PCOCs) exist at the primary release sites (PRS) or PRS aggregates. Secondary goals are to consider further action alternatives should PCOCs be identified. This RFI satisfies part of the regulatory requirements contained in the Laboratory's permit to operate under RCRA issued by the Environmental Protection Agency (EPA).

Module VIII of the permit, known as the HSWA (Hazardous and Solid Waste Amendment) Module (the portion of the permit that responds to the requirements of HSWA) was issued by the 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 1085, and those, together with the four work plans to be submitted in 1994 and the 19 work plans previously submitted to the EPA, meet the requirement set forth in the HSWA Module to address a cumulative percentage of the Laboratory's SWMUs in RFI work plans by May 21, 1994.

OU 1085 includes Technical Areas (TAs) 12, 14, and 67 and two potential release sites (PRSs) within TA-15 in Los Alamos County. TA-12 has been abandoned since 1953, and its definitive boundaries are not known. Structure numbers indicate that buildings in TA-12 are currently located in TA-15 and the newly formed (1989) TA-67. In addition, TA-67 acts as a buffer zone among firing sites at TA-14, TA-15, and TA-16 and other Laboratory sites. There are 44 PRSs in OU 1085, which are located on land owned by the Department of Energy (DOE).

Installation Work Plan

The HSWA Module required that the Laboratory prepare an Installation Work Plan (IWP) to describe the Laboratory-wide system for accomplishing the RFI, CMSs, and corrective measures. This requirement was satisfied by submitting the IWP for environmental restoration to the EPA in November 1990. That document is updated annually, and the most recent revision (Revision 3) was published in November 1993. The IWP identifies the Laboratory's PRSs, divides them into 24 OUs, 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 a version of that document.

Both the IWP and this work plan address radioactive materials and other hazardous substances not subject to RCRA. Sites that were not defined as SWMUs but that may contain hazardous substances, including non-RCRA materials, are called Areas of Concern (AOCs). The term PRS is the generic name for both SWMUs and AOCs.

The work plan includes sites that are not identified in the HSWA Module and are outside the regulatory scope of the operating permit. These units are included to ensure that all potential environmental problems at each OU are investigated and that the public and the regulators are presented with a unified plan that addresses all potential environmental problems on site. Inclusion of these sites in the work plan does not confer additional regulatory responsibility or authority for these sites to the regulators and does not bind the Laboratory to additional commitments outside the scope of the permit. The Laboratory will consider all comments received on this work plan.

Background

The technical areas constituting OU 1085 were constructed during World War II by the Explosives Division (X Division) to test explosives. TA-12, known as L-site, was considered to be abandoned by 1953. TA-12 was incorporated into the boundaries of TA-67, established in 1989, when the Laboratory redefined the technical area boundaries. All PRSs in the former TA-12 are inactive and most structures have been removed. TA-14 remains an active site with tests being scheduled at both a firing area and a bullet test facility. Active PRSs in TA-14 include components of a firing site, surface disposal areas, waste storage areas, an incinerator, and a sump and outfall. Nonactive PRSs include an abandoned shot pad, an incinerator, the sites of burned structures, and a septic system. Currently, experimental high explosives (HEs) are subjected to performance testing, and radioactive materials have been used in some experiments. TA-67 is considered a buffer zone and, except for the TA-12 portion, has not been used for any Laboratory operations and contains no SWMUs.

Technical Approach

For the purposes of designing and/or implementing the sampling and analysis plans described in this work plan, most PRSs have been grouped into aggregates. However, selected PRSs are investigated individually. This work plan presents the description and operating history of each PRS or aggregate, together with an evaluation of any existing data in order to develop a preliminary conceptual exposure model for the site. For some sites, no further action (NFA) can be proposed on the basis of this review; these sites are discussed in Chapter 6 of this work plan. For other, currently active sites, this review is sufficient to permit us to determine that investigation and remediation (if required) may be deferred until the site has been decommissioned. These sites, and the sites for which RFI fieldwork and/or voluntary corrective actions (VCAs) are proposed, are discussed in Chapter 5.

The technical approach to field sampling followed in this work plan 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 has been used to ensure that any environmental impacts associated with past and present activities are investigated in a manner that is cost-effective and complies with the HSWA Module. This phased approach permits intermediate data evaluation with opportunities for additional sampling, if required. If the data collected during Phase I are insufficient to support a baseline risk assessment, additional RFI Phase II sampling will be undertaken to characterize in more detail, the nature and extent of the release.

For some PRSs in OU 1085, there are existing data and/or strong historical evidence to support the hypothesis that a release has occurred. In these cases, the existing information has been evaluated to determine whether it is sufficient to support a baseline risk assessment and/or the evaluation of remedial alternatives. If the information for these sites is deemed insufficient, Phase I data will be collected to permit us to refine the site conceptual exposure model.

To ensure that the right type, amount, and quality of data are collected, we will develop data quality objectives that support the required decisions for the RFI Phase I sampling and analysis plans. Fieldwork for many sites will include field surveys and field screening of samples on which the selection of samples for laboratory analysis will be based. Laboratory analyses will be performed in mobile and fixed analytical laboratories.

The body of this work plan is followed by five annexes that consist of project plans corresponding to the program plans in the IWP: Annex I, Program Management Plan; Annex II, Quality Program Plan (LANL 1991, 0840); Annex III, Health and Safety Program Plan; Annex IV, Records Management Plan; and Annex V, Public Involvement Program Plan.

Schedule, Costs, and Reports

The RFI fieldwork described in this document will require 2 years to complete (Figure E-1). A single phase of fieldwork is expected to be sufficient for us 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 additional field activities will be defined in work plans deliverable in 1996.

Cost estimates for OU 1085 baseline activities are provided in Table E-1. The estimated cost for implementation of the RFI and reporting is $2.442 million. If a CMS is necessary, the estimated cost for implementation and reporting is $1.074 million. The total estimated cost for the corrective action process at OU 1085 is approximately $3.516 million.

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 plans. 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;
- 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.

Public Involvement

Regulations issued pursuant to the HSWA Module of the Laboratory's hazardous waste operating permit mandate public involvement in the corrective action process. The Laboratory provides a variety of opportunities for public involvement, including holding meetings to disseminate information, to discuss significant milestones, and to solicit informal public review of the draft work plans. The Laboratory 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 from 9:00 a.m. to 4:00 p.m. on Laboratory business days at the Laboratory'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.

TABLE E-1

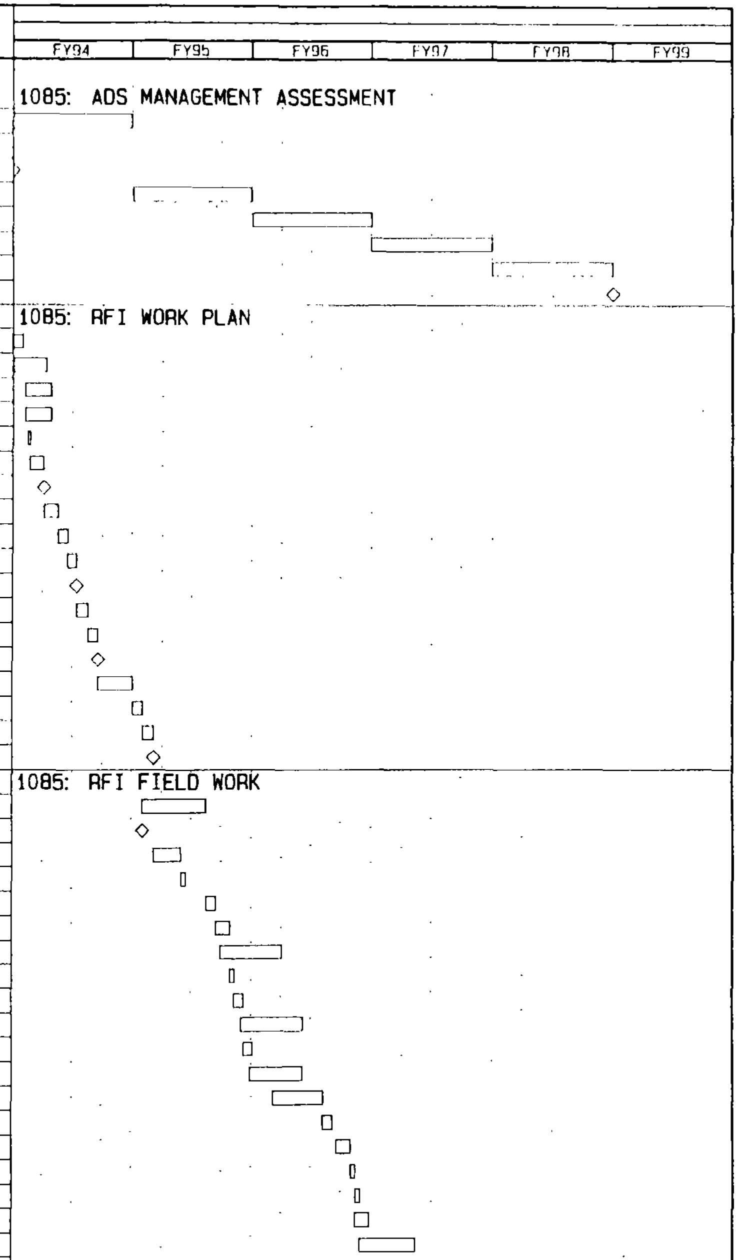
ESTIMATED COSTS OF BASELINE ACTIVITIES AT OU 1085

(ASSESSMENT PHASE * ONLY)

TASK	BUDGET ($K)	SCHEDULE D START	SCHEDULED FINISH
RFI work plans	387.2	10/1/93	12/2/94
RFI field work	680.1	11/2/94	7/2/97
RFI report	634.8	3/4/96	6/5/98
Activity data sheet (ADS) management	774.1	10/1/93	9/17/99
Voluntary corrective action	1040.3	3/1/95	9/17/99
Total	3516.7	10/1/93	9/17/99
Estimate to completion			
Escalation			
Prior years			
Total at completion			

* 3/1/94 Baseline change proposal

ACTIVITY ID	ACTIVITY DESCRIPTION		CAL ID	EARLY START	EARLY FINISH	ORIG DUR	BUDGET COST
1085: ADS MANAGEMENT ASSESSMENT							
080110904	1085: MANAGE ADS DURING FY-94	(LOE)	1	1OCT93	30SEP94	249	34070.00
08011FY94	1085: START FY94 ACTIVITIES		1	1OCT93	1OCT93	1	.00
08011M100	1085: START ASSESSMENT ADS MANAGEMENT	(LOE)	1	1OCT93		0	170.00
080110905	1085: MANAGE ADS DURING FY-95	(LOE)	1	3OCT94	29SEP95	248	33900.00
080110906	1085: MANAGE ADS DURING FY-96	(LOE)	1	2OCT95	30SEP96	249	33900.00
080110907	1085: MANAGE ADS DURING FY-97	(LOE)	1	1OCT96	30SEP97	249	33900.00
080110908	1085: MANAGE ADS DURING FY-98	(LOE)	1	1OCT97	30SEP98	249	33900.00
08011M105	1085: COMPLETE ASSESSMENT ADS MANAGEMENT	(LOE)	1		30SEP98	0	.00
1085: RFI WORK PLAN							
080120050	1085: DEVELOP HEALTH AND SAFETY PLAN	RFI WP	1	4OCT93	1NOV93	20	4044.51
080120066	1085: DEVELOP NEPA DOCUMENTATION	RFI WP	1	4OCT93	11JAN94	65	71543.34
080120062	1085: NM REVIEW /APPROVE ARCH/BIO REPORT	RFI WP	1	9NOV93	26JAN94	50	7341.30
080120063	1085: USFW REVIEW/APPROVE ARCH/BIO REPORT	RFI WP	1	9NOV93	26JAN94	50	7341.30
080120106	1085: INFORMAL WP REVIEW (INT)	RFI WP	1	17NOV93	23NOV93	5	2191.44
080120110	1085: INCORP REVIEW COMMENTS	RFI WP	1	24NOV93	4JAN94	25	8676.78
08012M101	1085: COMPLETE 2ND DRAFT WP	RFI WP	1		4JAN94	0	.00
080120112	1085: FORMAL WP REVIEW (VF) DOE	RFI WP	1	5JAN94	16FEB94	30	2191.44
080120145	1085: INCORP EPA COMMENTS	RFI WP	1	17FEB94	17MAR94	20	8676.78
080120115	1085: INCORP REVIEW COMMENTS	RFI WP	1	18MAR94	14APR94	20	8676.78
08012M115	1085: DOE DRAFT COMPLETE (3RD DRAFT)	RFI WP	1		14APR94	0	.00
080120120	1085: DOE WORK PLAN REVIEW	RFI WP	1	15APR94	19MAY94	25	2191.44
080120125	1085: INCORP DOE COMMENTS	RFI WP	1	20MAY94	17JUN94	20	8676.78
08012M130	1085: EPA DRAFT COMPLETE	RFI WP	1		17JUN94	0	.00
080120130	1085: ISSUE WP FOR EPA REVIEW	RFI WP	1	20JUN94	4OCT94	75	.00
080120146	1085: INCORP EPA COMMENTS	RFI WP	1	5OCT94	2NOV94	20	8676.78
080120150	1085: ISSUE FINAL RFI WP	RFI WP	1	3NOV94	5DEC94	20	.00
08012M150	1085: RFI WORK PLAN COMPLETE	RFI WP	1		5DEC94	0	.00
1085: RFI FIELD WORK							
080131002	1085: TA-12, 67 RFI FIELD PLANNING	RFI PH1	1	3NOV94	15MAY95	130	20745.30
08013M000	1085: START RFI FIELD PLANNING	RFI PH1	1	3NOV94		0	.00
080131001	1085: WRITE CONTRACTS	RFI PH1	1	6DEC94	27FEB95	55	8814.00
080131000	1085: MOBILIZE	RFI PH1	4	28FEB95	13MAR95	10	16535.00
080131202	1085: TA-12, 67 CONDUCT SITE SURVEY	RFI PH1	2	16MAY95	13JUN95	20	15865.70
080131210	1085: TA-12, 67 CONDUCT SITE SAMPL	RFI PH1	2	14JUN95	26JUL95	30	32938.24
080131402	1085: TA-12, 67 CONDUCT SAMPL ANAL	RFI PH1	1	28JUN95	2JAN96	126	86156.00
080131209	1085: TA-14 CONDUCT SITE SURVEYS	RFI PH1	2	27JUL95	9AUG95	10	12330.70
080131211	1085: TA-14 CONDUCT SITE SAMPLING	RFI PH1	2	10AUG95	7SEP95	20	34805.84
080131403	1085: TA-14 SAMPLE ANALYSIS	RFI PH1	1	31AUG95	7MAR96	126	83449.00
080131800	1085: DEMOBILIZE	RFI PH1	1	8SEP95	5OCT95	20	5510.00
080131602	1085: TA-12, 67 PH 1 DATA ASSESSMENT	RFI PH1	1	27SEP95	4MAR96	105	49723.19
080131603	1085: TA-14 PH 1 DATA ASSESSMENT	RFI PH1	1	5DEC95	6MAY96	105	38673.60
080132000	1085: PREPARE FOR PHASE 2 RFI	RFI PH2	1	7MAY96	5JUN96	21	.00
080132001	1085: WRITE CONTRACTS/MOBILIZE	RFI PH2	1	19JUN96	31JUL96	30	25349.00
080132202	1085: TA-12, 67 CONDUCT SITE SURVEYS	RFI PH2	4	1AUG96	14AUG96	10	2061.80
080132203	1085: TA-14 CONDUCT SITE SURVEYS	RFI PH2	4	15AUG96	28AUG96	10	1388.75
080132210	1085: TA-12, 67 CONDUCT SITE SAMPL	RFI PH2	2	15AUG96	26SEP96	30	13045.40
080132402	1085: TA-12, 67 CONDUCT SAMPL ANAL	RFI PH2	1	29AUG96	11FEB97	110	28845.00



Plot Date 12MAY94
Data Date 1OCT93
Project Start 1OCT92
Project Finish 17SEP99

(c) Primavera Systems, Inc.

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

4Y85

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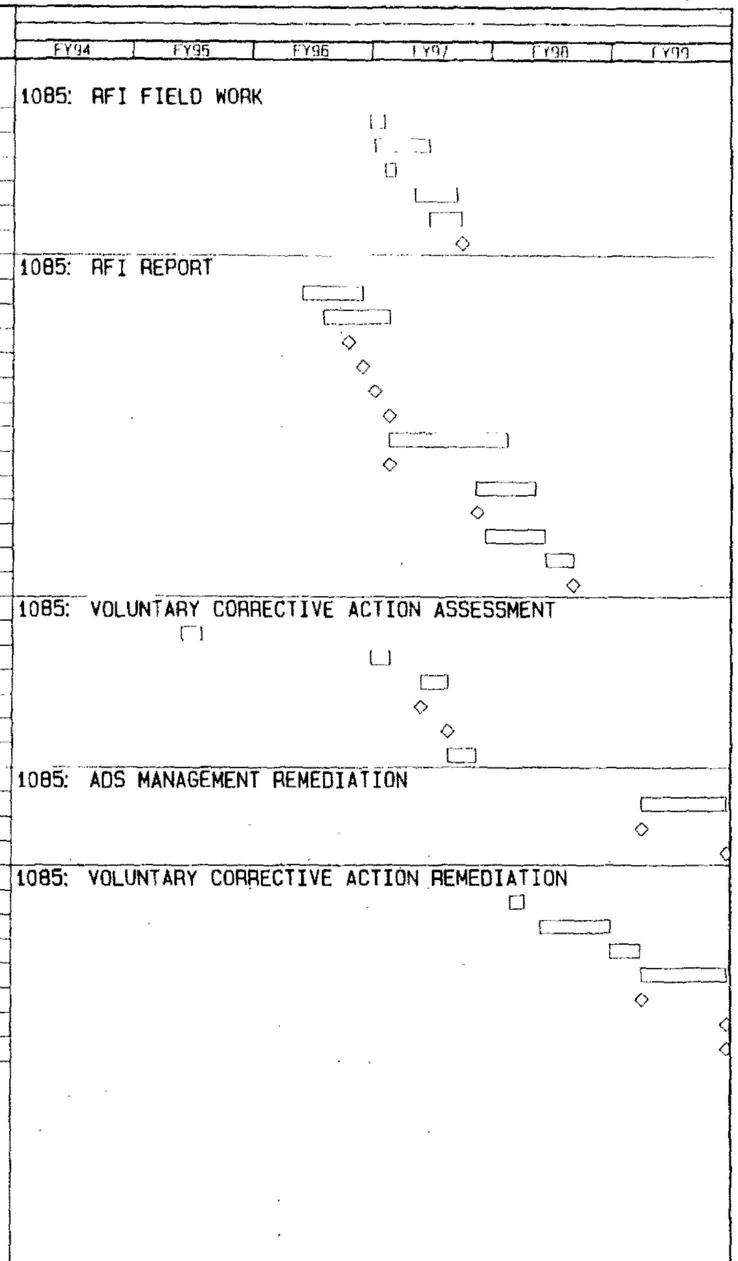
LOS ALAMOS NATIONAL LABORATORY
ADS 1085: TA-12, 14, 67
(BC-10) Baseline Working Schedule

ENVIRONMENTAL RESTORATION

Date	Revision	Checked	Approved

ACTIVITY ID	ACTIVITY DESCRIPTION		CAL ID	EARLY START	EARLY FINISH	ORIG DUR	BUDGET COST
1085: RFI FIELD WORK							
080132214	1085: TA 14 CONDUCT SITE SAMPLING	RFI PH2	1	27SEP96	8NOV96	30	13535.96
080132404	1085: TA-14 PH2 SAMPLE ANALYSIS	RFI PH2	1	11OCT96	26MAR97	110	27712.00
080132800	1085: DEMOBILIZE	RFI PH2	1	12NOV96	11DEC96	20	5510.00
080132602	1085: TA 12, 67 PH2 DATA ASSESSMENT	RFI PH2	1	12FEB97	19JUN97	90	15574.40
080132604	1085: TA-14 PH2 DATA ASSESSMENT	RFI PH2	1	27MAR97	3JUL97	70	11049.60
08013M500	1085: RFI FIELD WORK COMPLETE	RFI PH2	1		3JUL97	0	.00
1085: RFI REPORT							
080140100	1085: TA-12, 67 PREPARE PH1 REPORT/WP MOD	PH1 RPT	1	5MAR96	5SEP96	130	26689.11
080140101	1085: TA-14 PREPARE PH1 REPORT/WP MOD	PH1 RPT	1	7MAY96	25NOV96	140	52993.27
08014M130	1085: TA-12, 67 ISSUE EPA DRAFT	PH1 RPT	1	25JUL96		0	.00
08014M150	1085: TA-12, 67 REPORT CMPL	PH1 RPT	1		5SEP96	0	.00
08014M131	1085: TA-14 ISSUE EPA DRAFT	PH1 RPT	1	11OCT96		0	.00
08014M151	1085: TA-14 RPT CPL	PH1 RPT	1		25NOV96	0	.00
080140305	1085: RFI REPORT	PH2 RPT	1	26NOV96	20NOV97	246	21736.44
08014M300	1085: START DEVELOPING RFI REPORT	PH2 RPT	1	26NOV96		0	.00
080140102	1085: TA-12, 67 PREPARE PH2 REPORT	PH2 RPT	1	18AUG97	12FEB98	120	8823.85
08014M330	1085: ISSUE EPA DRAFT	RFI RPT	1	21AUG97		0	.00
080140103	1085: TA-14 PREPARE PH2 REPORT	PH2 RPT	1	16SEP97	13MAR98	120	38404.82
080140350	1085: PREPARE FINAL RFI REPORT	RFI RPT	1	16MAR98	8JUN98	60	10868.22
08014M350	1085: ISSUE FINAL RFI RPT	RFI RPT	1		8JUN98	0	.00
1085: VOLUNTARY CORRECTIVE ACTION ASSESSMENT							
080180800	1085: TREATABILITY STUDIES VCA'S		3	1MAR95	1MAY95	44	168144.00
080180107	1085: PREPARE VCA PLAN FY97		1	1OCT96	27NOV96	40	.00
080180807	1085: CONDUCT VCA FY97		3	3MAR97	23MAY97	60	318702.00
08018M000	1085: START VCA ASSESSMENT		1	3MAR97		0	318702.00
08018M110	1085: VCA ASSESSMENT COMPLETE		3		23MAY97	0	318702.00
080180108	1085: PREPARE VCA REPORT-FY97		1	27MAY97	19AUG97	60	.00
1085: ADS MANAGEMENT REMEDIATION							
080210925	1085: SUPERVISE SOILS REMEDIATION	(LOE)	1	4JAN99	17SEP99	180	13560.00
08021M100	1085: START ADS MGMT REMEDIATION	(LOE)	1	4JAN99		0	.00
08021M105	1085: COMPLETE ADS MANAGEMENT REMEDIATION	(LOE)	1		17SEP99	0	.00
1085: VOLUNTARY CORRECTIVE ACTION REMEDIATION							
080280109	1085: PREPARE VCA PLAN-FY98		1	1DEC97	14JAN98	30	.00
080280808	1085: CONDUCT VCA FOR FY98	(LOE)	3	2MAR98	29SEP98	149	205970.00
080280104	1085: PREPARE VCA REPORT-FY98		1	30SEP98	30DEC98	60	.00
080280826	1085: SOILS REMEDIATION		1	4JAN99	17SEP99	180	127200.00
08028M000	1085: START VCA SOILS REMEDIATION		1	4JAN99		0	.00
08028M510	1085: VCA SOILS REMEDIATION COMPLETE		1		17SEP99	0	.00
08028M750	1085: PROJECT COMPLETE		1		17SEP99	0	.00



Plot Date 12MAY94
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Project Start 1OCT92
Project Finish 17SEP99

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

4V85

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LOS ALAMOS NATIONAL LABORATORY
ADS 1085: TA-12, 14, 67
(BC-10) Baseline Working Schedule

ENVIRONMENTAL RESTORATION

Date	Revision	Checked	Approved

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AC	alternating current
ADS	Activity Data Sheet
AEA	Atomic Energy Act
ALARA	as low as reasonably achievable
AOC	Area of Concern
AR	administrative requirement
BRET	Biological Resource Evaluation Team
BTEX	benzene, toluene, ethylbenzene, xylene
CDU	capacitive discharge unit
CEARP	Comprehensive Environmental Assessment and Response Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CMS	Corrective Measures Study
COC	contaminant of concern
DA	deferred action
D&D	decontamination and decommissioning
DNT	dinitrotoluene
DOE	Department of Energy
DQO	data quality objective
DX Division	Dynamic Experimentation Division

EM	environmental management
EM Division	Environmental Management Division
EPA	Environmental Protection Agency
ER	environmental restoration; Environmental Restoration Program
ES&H	environment, safety, and health
FID	flame ionization detector
FS	feasibility study
FT	facility transition
GC	gas chromatography
GC/MS	gas chromatography/mass spectrometry
GMX-2	Explosives Research and Development Group
GMX-7	Detonators, Firing, and Cables Group
HE	high explosive
HMX	cyclotetramethylene tetranitramethylene
HSWA	Hazardous and Solid Waste Amendments
IWP	Installation Work Plan
LANL	Los Alamos National Laboratory (the Laboratory's name since since January 1, 1981)
LASL	Los Alamos Scientific Laboratory (the Laboratory's name through December 31, 1980)
LAW	light armor weapon
LIBS	laser-induced breakdown spectroscopy

M Division	Dynamic Testing Division
M-1	Explosives Technology Group
M-6	Flash Photography Group
M-8	Explosives Applications Group
MCL	maximum contaminant level
MDA	material disposal area
MWDF	Mixed Waste Disposal Facility
NEPA	National Environmental Policy Act
NFA	no further action
NMED	New Mexico Environment Department
OU	operable unit
PAH	polynuclear aromatic hydrocarbon
PCOC	potential contaminant of concern
PETN	Pentaerythitol tetranitrate
PID	photoionization detector
PQL	practical quantitation limit
PRS	potential release site
QA	quality assessment
QC	quality control
RCRA	Resource Conservation and Recovery Act
RDX	cyclotrimethylenetrinitramine; also known as cyclonite or hexahydro-trinitro-triazine

RFI	RCRA Facility Investigation
RI	remedial investigation
RME	reasonable maximum exposure
SAL	screening action level
SOP	standard operating procedure
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
SWSC	Sanitary Wastewater Systems Consolidation
TA	technical area
TCLP	Toxic Constituent Leach Procedure
Tetryl	2,4,6-trinitrophenylmethylnitramine
TNB	trinitrobenzene
TNT	2,4,6-trinitrotoluene
TPH	total petroleum hydrocarbon
TRU	transuranic
TSD	treatment, storage, and disposal
TSR	technical safety requirement
VCA	voluntary corrective action
X Division	Explosives Division (1944–1948); GMX (1948–1972)
X-1B	Terminal Observations Group
X-8	Detonation Wave Research
XRF	x-ray fluorescence

WX Division	Design Engineering Division
WX-2	Explosives R&D Group (1972–1981)

CHAPTER 1

INTRODUCTION

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 program, which is implemented by the Environmental Protection Agency (EPA) or by a state which is authorized to implement the program, and set standards for all hazardous waste-management operations at a given 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). At present, EPA administers the HSWA requirements in New Mexico. In accordance with this statute, the Laboratory's permit to operate includes a section, referred to as the HSWA Module, that prescribes a specific corrective action program for the Laboratory (EPA 1990, 0306). The HSWA Module includes provisions for mitigating releases from facilities currently in operation and for cleaning up inactive sites. The primary purpose of this Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) work plan is to determine if Potential Contaminants of Concern (PCOCs) exist at the primary release sites (PRS) or PRS aggregates. 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) (DOE 1989, 0078).

The HSWA Module lists SWMUs and defines them 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 182 SWMUs that must be investigated first. In addition, the Laboratory has identified Areas of Concern (AOCs) that do not meet the HSWA Module's definition of a SWMU. These sites may contain radioactive materials and other hazardous substances listed under CERCLA. SWMUs and AOCs are collectively referred to as potential release sites (PRSs). The Environmental Restoration (ER) Program uses the mechanism of recommending no further action (NFA) for AOCs as well as SWMUs. However, 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 OUs, and an RFI work plan has been or will be prepared for each. This work plan for OU 1085, due to the EPA by May 1994, addresses PRSs located in four of the Laboratory's technical areas (TAs): TA-12, TA-14, TA-15, and TA-67. This plan, together with 18 other work plans already submitted to EPA, meets the schedule requirement of the HSWA Module, which is to address a cumulative total of 55% of the SWMUs in Table A and a cumulative total of 100% of the 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 RCRA Facility Investigation (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.

TABLE 1-1
RCRA FACILITY INVESTIGATION GUIDANCE FROM THE HSWA MODULE

SCOPE OF THE RCRA FACILITY INVESTIGATION*	ER PROGRAM EQUIVALENT	
The RFI consists of 5 tasks:	*Laboratory Installation RI/FS* Work Plan:*	*Laboratory Task/Site RI/FS:*
Task I: Description of Current Conditions A. Facility background B. Nature and extent of contamination	**I. Laboratory Installation RI/FS Work Plan** A. Installation background B. Tabular summary of contamination by site	**I. OU 1085 Work Plan** A. Task/site background B. Nature and extent of contamination
Task II: RFI Work Plan A. Data collection/Quality Assurance Plan B. Data Management Plan C. Health and Safety Plan D. Public Involvement Plan	**II. Laboratory Installation RI/FS Work 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 Plan	**II. Laboratory Task/Site RI/FS Documents** 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 A. Environmental setting B. Source characterization C. Contamination characterization D. Potential receptor identification	**III. Task/Site Investigation** A. Environmental setting B. Source characterization C. Contamination characterization D. Potential receptor identification	**III. Task/Site Investigation** A. Environmental setting B. Source characterization C. Contamination characterization D. Potential receptor identification
Task IV: Investigative Analysis A. Data analysis B. Protection standards	**IV. Laboratory Task/Site Investigative Analysis** A. Data analysis B. Protection standards	**IV. Laboratory Task/Site Investigative Analysis** A. Data analysis B. Protection standards
Task V: Reports A. Preliminary and final work plan B. Progress C. Draft and final reports	**V. Reports** A. Laboratory installation RI/FS work plan B. Annual update of Laboratory installation RI/FS Work Plan C. Draft and final reports	**V. Laboratory Task/Site Reports** A. Quality Assurance Project Plan, Field Sampling Plan, Technical Data Management Plan, Health and Safety Plan, Public Involvement Plan B. Laboratory task/site RI/FS documents and Laboratory monthly management status report C. Draft and final reports

*RFI = RCRA Facility Investigation, RI = remedial investigation, FS = feasibility study

TABLE 1-2
LOCATION OF HSWA MODULE REQUIREMENTS IN ER PROGRAM DOCUMENTS

HSWA MODULE REQUIREMENTS FOR RFI WORK PLANS	INSTALLATION WORK PLAN AND OTHER PROGRAM DOCUMENTS	DOCUMENTS FOR OU 1085
Task I: Description of Current Conditions		
A. Facility background	IWP Subsection 2.1	A. RFI Work Plan, Chapters 2, 3, and 5
B. Nature and extent of contamination	IWP Subsection 2.4 and Appendix F	B. RFI Work Plan, Chapter 5
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. Community Relations 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 Subsection 4.2	RFI Work Plan, Chapters 4 and 5
Task IV: Investigative Analysis		
A. Data analysis	IWP Subsection 4.2	Phase reports and RFI report
B. Protection standards	IWP Subsection 4.2a	RFI report
Task V: Reports		
A. Preliminary and final Work Plans	IWP Rev. 0	Work plan
B. Progress	Monthly reports, quarterly reports, annual revisions of IWP	Phase reports
C. Draft and final reports		Draft and final RFI reports

* Annex II of the IWP addresses these requirements by reference to controlled documents: The Generic Quality Assurance Project Plan (LANL 1991, 0553) and the ER Program's standard operating procedures (LANL 1993, 0875).

1.2 Installation Work Plan

The HSWA Module requires that the Laboratory prepare a master plan (the IWP) that describes 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 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 OUs (Subsection 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 contain the Program Management Plan, Quality Program Plan (LANL 1991, 0840), Health and Safety Program Plan, Records Management Program Plan, and the Public Involvement Program Plan, respectively. The IWP contains a proposal to integrate RCRA closure with corrective action, as well as 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 appropriate revision of the IWP.

1.3 Description of OU 1085

OU 1085 is located in Los Alamos County in north-central New Mexico within the northwestern quadrant of the Laboratory complex (Figure 1-1). It is approximately 1.75 miles long and 0.7 miles wide at its widest point and is situated near the head of Pajarito and Three-Mile Mesas, which separate 180-ft-deep Pajarito Canyon on the north from 100-ft-deep Cañon de Valle on the south. Three-Mile Canyon, a tributary of Pajarito Canyon, originates in the OU and divides the mesa into two prongs. The area is forested with ponderosa pine, piñon, and juniper and may be accessed by State Route 501. All of the land comprising OU 1085 is located on property owned by the Department of Energy and managed by the Los Alamos National Laboratory (LANL).

The OU consists primarily of two operating technical areas, TA-14 (an active site which lies on the southern prong, Three-Mile Mesa) and TA-67 (on the northern prong, Pajarito Mesa), and one inactive site (TA-12) which lies primarily within TA-67 (Figure 1-2). No prominent physical features

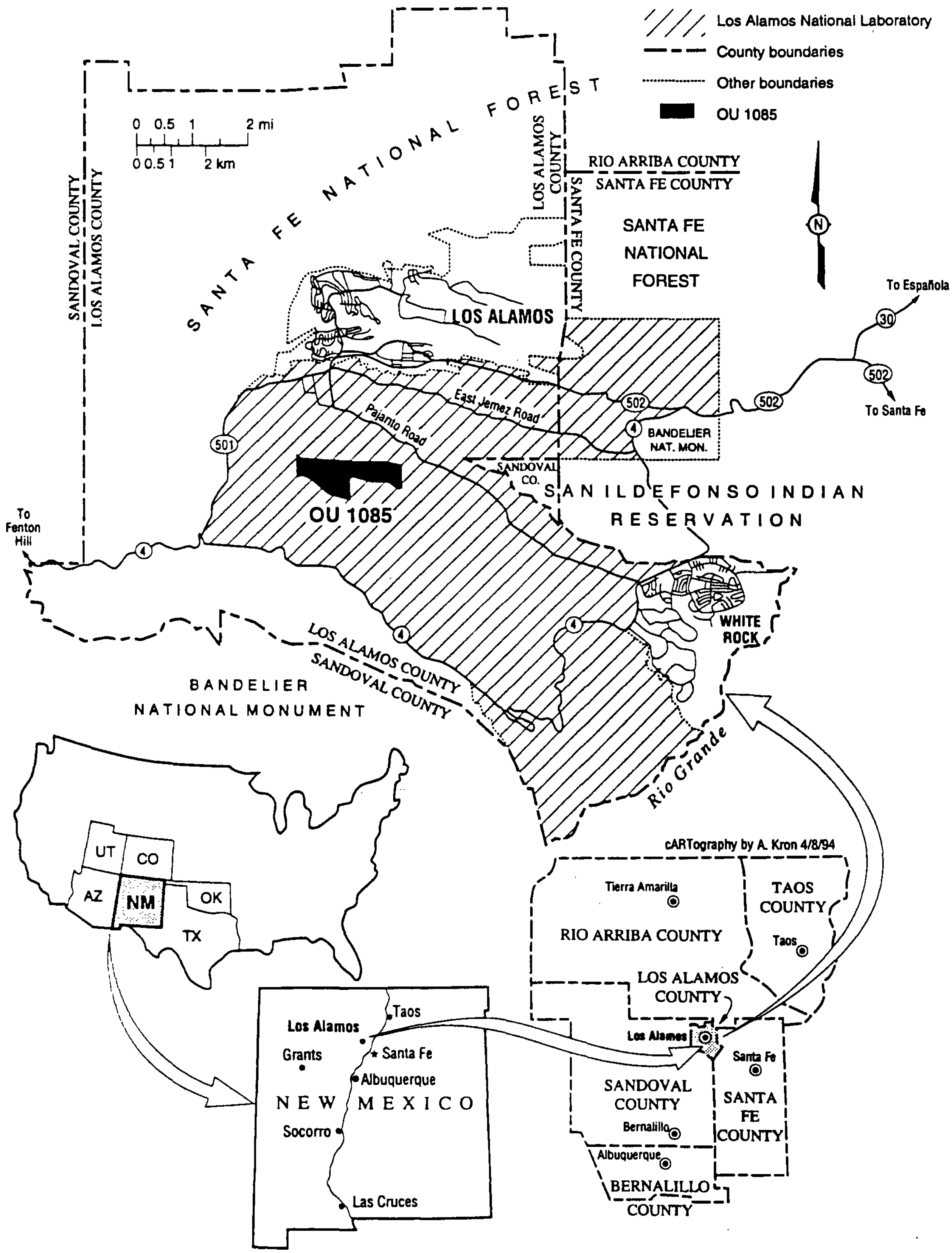


Figure 1-1. Location of Operable Unit 1085.

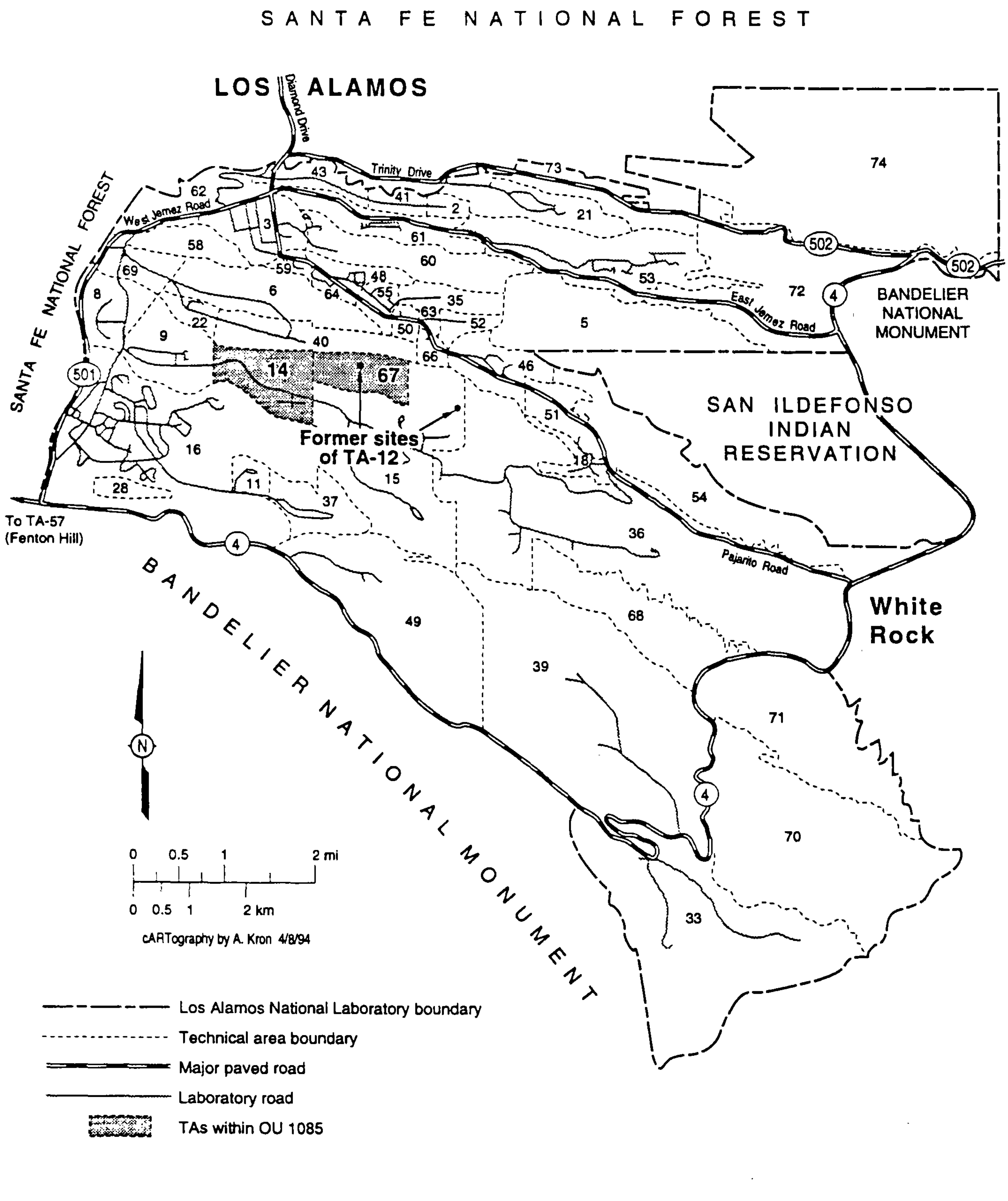


Figure 1-2. Location of Operable Unit 1085 with respect to Laboratory technical areas and surrounding landholdings.

mark the east or west boundaries. Technical Areas 12 and 14 were constructed during World War II by the Explosives Division (X Division) to test explosives. TA-12, known as L-site, was abandoned by 1953 and its boundaries were never clearly defined. As a result of the 1989 Laboratory redefinition of the technical boundaries, TA-12 is primarily located within TA-67. All PRSs in the former TA-12 site are inactive and most structures have been removed. TA-14, Q-site, was constructed for close observation work on small explosive charges and included both open and closed firing chambers. TA-14 has always been a dedicated site for the development and testing of explosives, including tests involving radioactive materials, and remains an active site with scheduled tests at both a firing area and bullet test facility. TA-67 was established in 1989 when the Laboratory redefined the technical area boundaries. This site is considered to be a buffer zone between the firing sites and other TAs. LANL is proposing a Mixed Waste Disposal Facility (MWDF) which may be located at TA-67; thus, site characterization and remediation schedules for the TA-12 aggregates may be subject to change, depending on the schedule for construction of the MWDF.

The PRSs for OU 1085 have been aggregated according to their common characteristics and/or the common approach that can be applied to them in the RFI work plan. There are six PRS aggregates. Two are located in TA-12: Aggregate 1 (Inactive Firing Site) and Aggregate 2 (Radioactive Lanthanum Site). PRSs in TA-14 are geographically and functionally consolidated into the remaining 4 aggregates: Aggregate 3 (Western Area), Aggregate 4 (Central Area), Aggregate 5 (Inactive Septic Tank), and Aggregate 6 (East Site and West Magazine). The locations of these PRSs are shown in Figures 1-3 through 1-6. The PRSs that will be investigated in Phase I of the RFI, those for which investigation has been deferred, and those which are candidates for voluntary corrective action are listed, by aggregate, in Table 1-3. These aggregates are discussed in detail in Chapter 5. PRSs recommended for NFA on the basis of archival information (see Chapter 4, Section [illegible].1, and Appendix I of the IWP [LANL] are listed in Table 1-4 and described in Chapter 6. A number of PRSs not listed in the HSWA Module are addressed in this work plan as a matter of efficiency and cost containment. Those PRS that are considered SWMUs in the HSWA module are identified as such (Tables 1-3 and 1-4). PRSs identified with a "C-" prefix are AOCs (Tables 1-3 and 1-4 and Figures 1-4 through-6).

Table 1-4 lists the PRSs recommended for NFA. EPA's approval of this work plan demonstrates EPA's concurrence with the Laboratory that these PRSs are viable candidates for removal from the ER Program via a permit modification. Subsection 3.5 of the IWP states that each OU work plan may contain an application for a Class III permit to modify Table A of the HSWA Module after it has been determined that a PRS needs no further investigation.

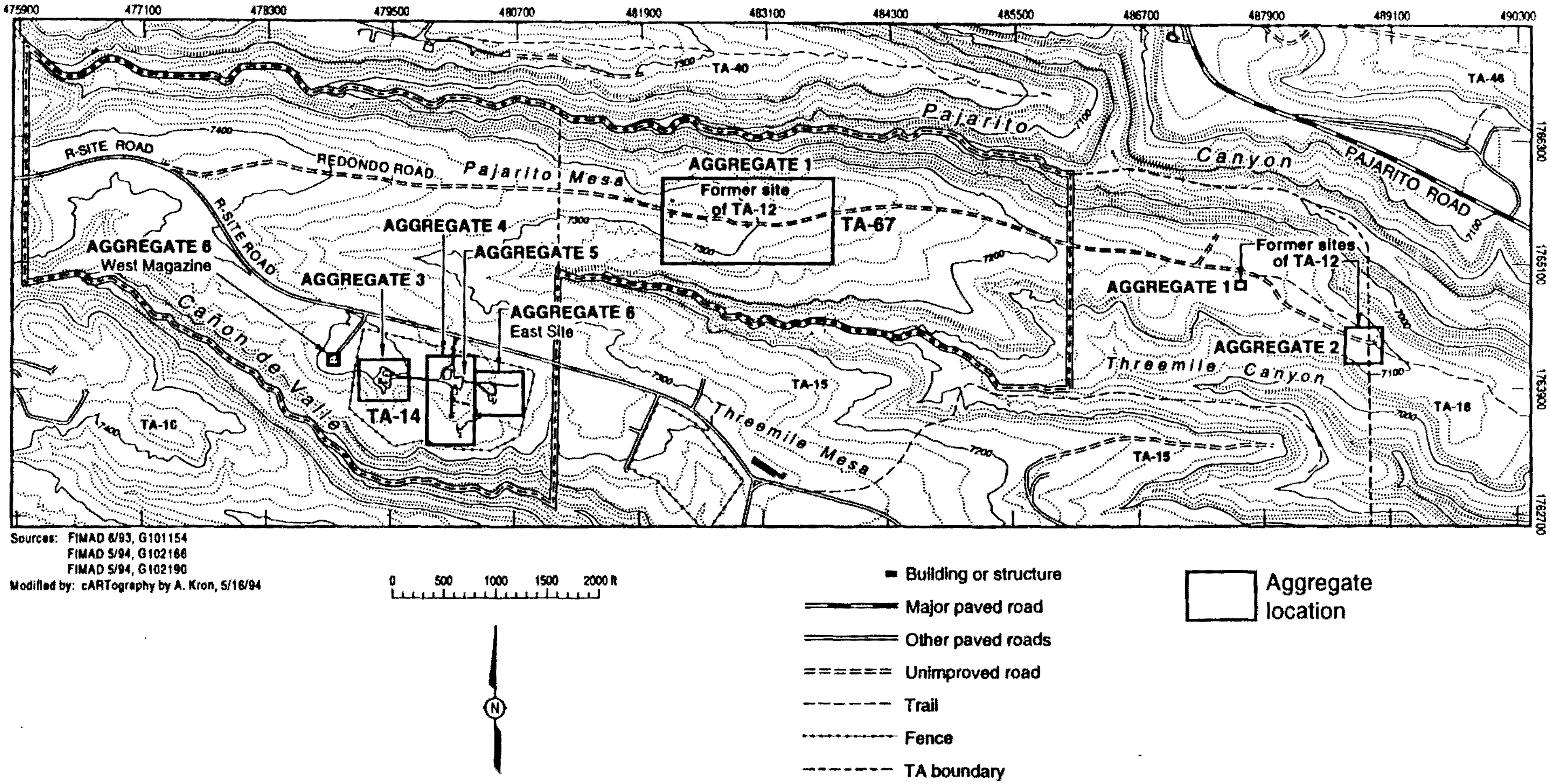
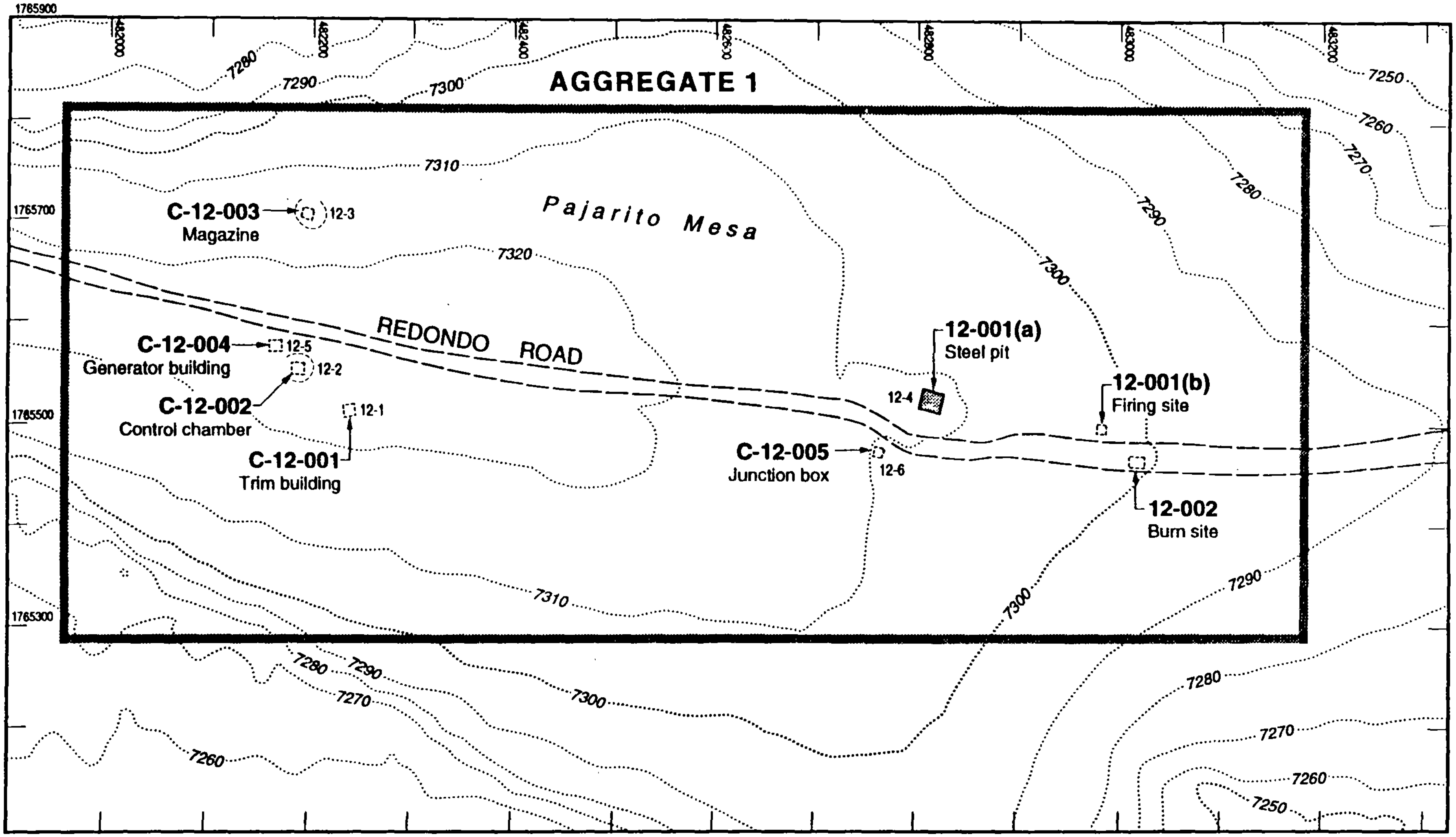


Figure 1-3. Locations of PRS Aggregates in OU 1085.



0 50 100 150 200 ft

Contour interval = 10 ft

Former structure

Permanent structure

Unimproved road

"C" Area of Concern (AOC)

N

Sources: FIMAD 1993 G101088
LASL 1950 ENG-R127
Modified by: cARTography by A. Kron 5/16/94

Figure 1-4. PRS locations in Aggregate 1—TA-12: Inactive Firing Sites.

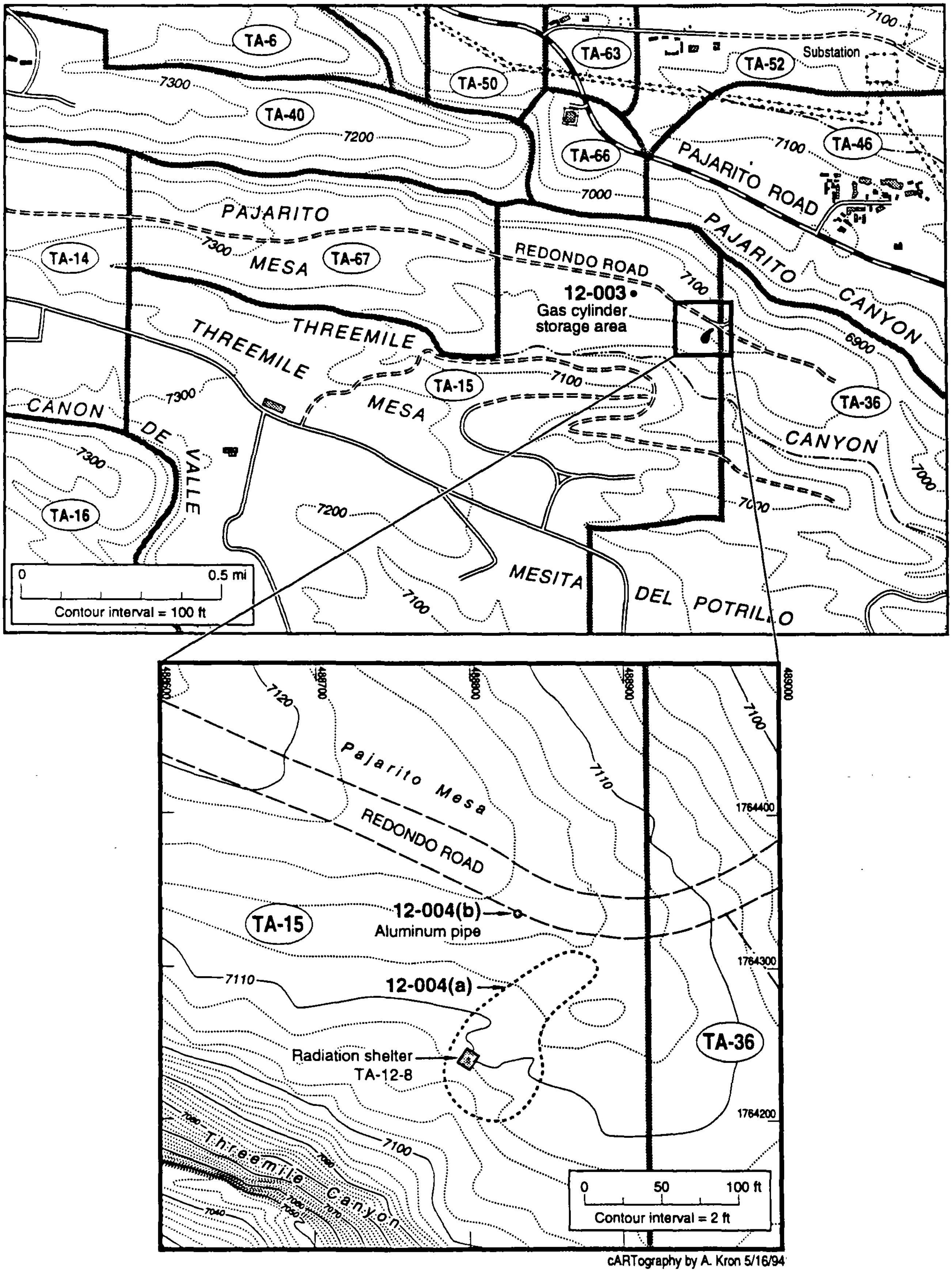


Figure 1-5. Location of Aggregate 2—Radioactive Lanthanum Site.

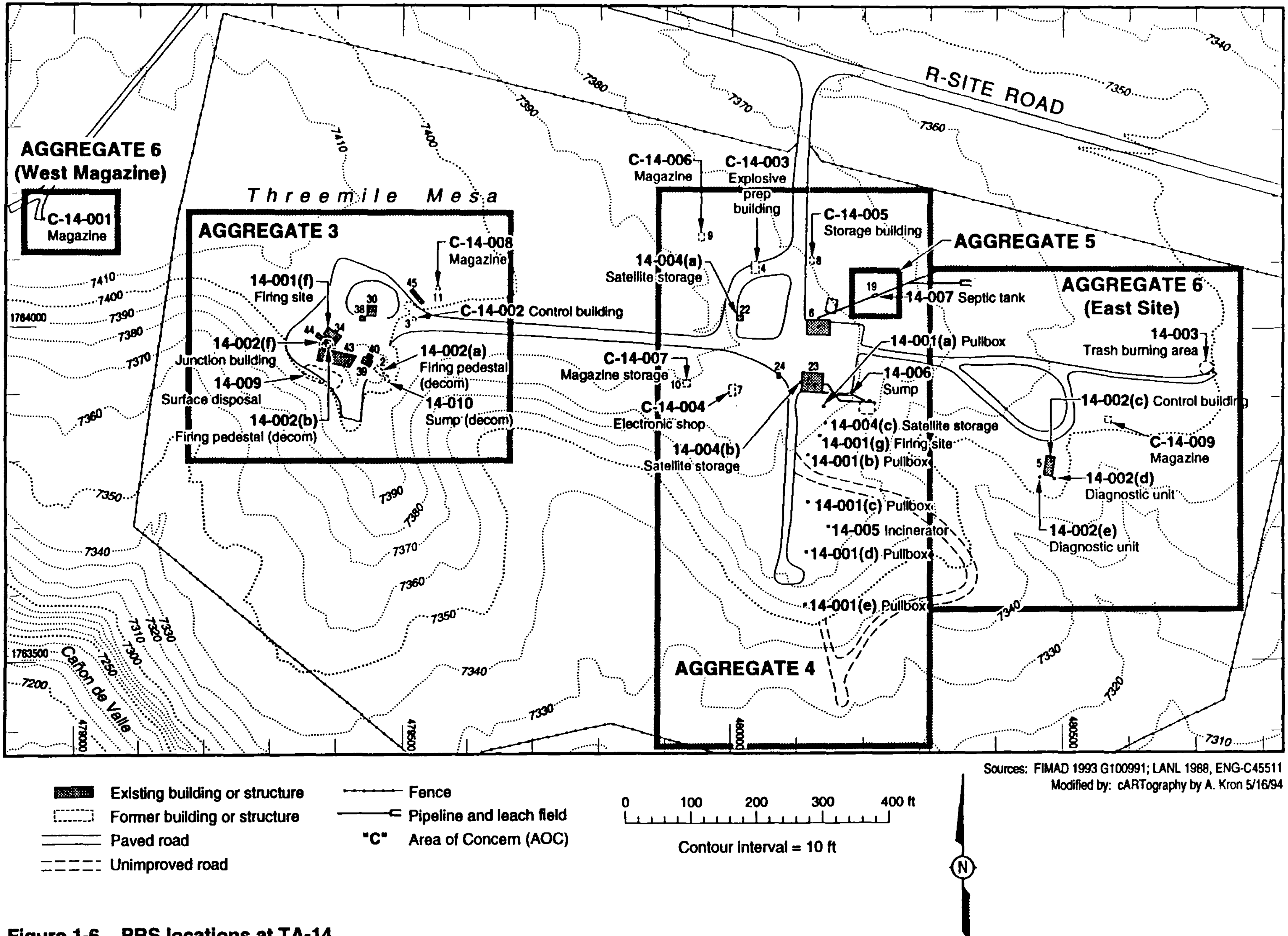


Figure 1-6 . PRS locations at TA-14.

Table 1.3 SWMUs and AOCs in OU 1085 Recommended for Investigation

PRS NO.	HSWA Permit SWMU	Work Plan Figure No.	Work Plan Section No.	Proposed Action	Description
Aggregate 1:	TA-12:	Inactive Firing Site			
12-001(a)	Yes	1-4	5.1	Characterize for HRA	TA-12-4, Steel pit (decommissioned firing site)
12-001(b)	Yes	1-4	5.1	Voluntary Corrective Action	Firing site (decommissioned)
C-12-001		1-4	5.1	Investigate	TA-12-1, Trim building (decommissioned)
C-12-002		1-4	5.1	Investigate	TA-12-2, Control building (decommissioned)
C-12-003		1-4	5.1	Investigate	TA-12-3, Magazine (decommissioned)
C-12-004		1-4	5.1	Investigate	TA-12-5, Generator building (decommissioned)
C-12-005		1-4	5.1	Investigate	TA-12-6, Junction box (decommissioned)
Aggregate 2:	Radioactive Lanthanum Site				
12-004(a)	No	1-5	5.2	Investigate	TA-12-8, Radiation shelter (decommissioned)
12-004(b)	No	1-5	5.2	Investigate	Aluminum pipe
Aggregate 3:	TA-14:	Western Area			
14-001(f)	No	1-6	5.3	Deferred Action	TA-14-34, Firing site (active)
14-002(a)	Yes	1-6	5.3	Deferred Action	TA-14-2: Firing site (decommissioned and removed)
14-002(b)	Yes	1-6	5.3	Deferred Action	TA-14-17, Firing pedestal (decommissioned and removed)
14-002(f)	Yes	1-6	5.3	Deferred Action	TA-14-12, Junction box (decommissioned and removed)
14-009	No	1-6	5.3	Deferred Action	Surface disposal area
14-010	No	1-6	5.3	Deferred Action	TA-14-2, sump (decommissioned)
C-14-002		1-6	5.3	Deferred Action	TA-14-3, Control building (removed)
C-14-008		1-6	5.3	Deferred Action	TA-14-11, Magazine (decommissioned and removed)
14-001(a)	No	1-6	5.4	Deferred Action	TA-14-25, Capacitive discharge unit (pullbox)
14-001(b)	No	1-6	5.4	Deferred Action	TA-14-26, Capacitive discharge unit (pullbox)
14-001(c)	No	1-6	5.4	Deferred Action	TA-14-27, Capacitive discharge unit (pullbox)
14-001(d)	No	1-6	5.4	Deferred Action	TA-14-28, Capacitive discharge unit (pullbox)
14-001(e)	No	1-6	5.4	Deferred Action	TA-14-29, Capacitive discharge unit (pullbox)
14-001(g)	No	1-6	5.4	Deferred Action	Active firing site
14-005	Yes	1-6	5.4	Deferred Action	Incinerator
14-006	No	1-6	5.4	Deferred Action	TA-14-31, Sump and outfall
C-14-003		1-6	5.4	Investigate	TA-14-4, Explosives preparation building
C-14-004		1-6	5.4	Investigate	TA-14-7, Electronics shop
C-14-005		1-6	5.4	Investigate	TA-14-8, Storage building (decommissioned)
C-14-006		1-6	5.4	Investigate	TA-14-9, Magazine (decommissioned)
C-14-007		1-6	5.4	Investigate	TA-14-10, Storage building (decommissioned)
Aggregate 5:	TA-14:	Septic Tank			
14-007	Yes		5.5	Investigate	TA-14-19, Septic tank (inactive)
Aggregate 6:	TA-14:	East Site and West Magazine			
14-002(c)	Yes	1-6	5.6	Investigate	TA-14-5, Firing site (decommissioned)
14-002(d)	Yes	1-6	5.6		Firing site (decommissioned)
14-002(e)	Yes	1-6	5.6		Firing site (decommissioned)
14-003	No	1-6	5.6		Burn area (inactive)
C-14-001		1-6	5.6		TA-14-1, Magazine (decommissioned and removed)
C-14-009		1-6	5.6		TA-14-13, Magazine (decommissioned and removed)

Table 1.4 PRSs Recommended for NFA

PRS NO.	HSWA Permit SWMU	Work Plan Figure No.	Work Plan Section No.	DESCRIPTION
Aggregate 1: TA-12: Inactive Firing Site				
12-002	No	1-4	6.2.4.1	Inactive burn site
12-003	No	1-5	6.2.4.2	Gas cylinder storage area
Aggregae 2: Radioactive Lanthanum Site				
C-12-006		1-5	6.	Contaminated Pole (duplicate reporting of one of the elements in 12-004(a))
Aggregate 4: TA-14: Central Area				
14-004(a)	No	1-6	6.	Satellite storage area
14-004(b)	Yes	1-6	6.	Satellite storage area
14-004(c)	No	1-6	6.	Satellite storage area
Unlocated PRS				
14-008	No		6.2.4.3	Landfill/surface disposal

1.4 Organization of this Work Plan and Other Useful Information

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 1085, which includes a description and history of the OU, a description of past waste management practices, and current conditions at TAs in the OU.

Chapter 3 describes the environmental setting. Chapter 4 presents the technical approach to the field investigation. 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 brief description of each PRS proposed for NFA and the rationale for that recommendation.

The body of the text is followed by five annexes, which consist of project plans corresponding to the program plans in the IWP: project management, quality assurance (LANL 1991, 0553), health and safety, records management, and public involvement. Appendix A contains the NEPA documentation, including the cultural and biological resource summary, Appendix B is an introduction to the explosives found in OU 1085, and Appendix C describes field investigation methods that will be used in the OU 1085 RFI.

Both English and metric units of measurement are used in this document and which unit is used depends on which is more commonly used in the field being discussed (Table 1-5). For example, English units are used in text pertaining to engineering, and metric units are often used in discussions of geology and hydrology. When information is derived from some other published report, the units are consistent with those used in that report.

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

TABLE 1-5

APPROXIMATE CONVERSION FACTORS FOR

SELECTED SI (METRIC) UNITS

MULTIPLY SI (METRIC) UNIT	BY	TO OBTAIN U.S. CUSTOMARY UNIT
Cubic meters (m^3)	35	Cubic feet (ft^3)
Centimeters (cm)	0.39	Inches (in.) meters
Meters (m)	3.3	Feet (ft)
Kilometers (km)	0.62	Miles
Square kilometers (km^2)	0.39	Square miles ($miles^2$)
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 (µg/g)	1	Parts per million (ppm)
Milligrams per liter (mg/L)	1	Parts per million (ppm)
Celsius (°C)	9/5 + 32	Fahrenheit (°F)

REFERENCES

DOE (US Department of Energy), October 6, 1989. "Comprehensive Environmental Response, Compensation, and Liability Act Requirements," DOE Order 5400.4, Washington, DC. (DOE 1989, 0078)

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. RCRA Permit No. NM0890010515, EPA Region 6, issued to Los Alamos National Laboratory, Los Alamos, New Mexico, effective May 23, 1990, EPA Region 6, 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. (EPA 1990, 0432)

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)

LANL (Los Alamos National Laboratory), June 1991. "Los Alamos National Laboratory Quality Program Plan for Environmental Restoration Activities," Rev. 0, Los Alamos National Laboratory report LA-UR-91-1844, Los Alamos, New Mexico. (LANL 1991, 0840)

LANL (Los Alamos National Laboratory), November 1991. "Installation Work Plan for Environmental Restoration," Revision 1, Los Alamos National Laboratory report LA-UR-91-3310, Los Alamos, New Mexico. (LANL 1991, 0553)

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)

CHAPTER 2

BACKGROUND INFORMATION

2.0 BACKGROUND INFORMATION

2.1 General Description

Operable Unit (OU) 1085 is located south and east of Los Alamos townsite (Figure 1-1). It is approximately 0.7 miles at its widest point in TA-14 and extends from TA-14 (at an elevation of about 7,500 ft) eastward 1.7 miles to TA-15 (where the elevation is about 7,200 ft). The operable unit is disected by Three-Mile Canyon, a tributary of Pajarito Canyon which originates in the OU and divides the mesa in two, forming Three-Mile Mesa on the south. OU 1085 is bounded on the north by Pajarito Canyon, on the south by Canon de Valle and the south and east by TA-15. TA-9 bounds the OU on the west (Figure 1-2).

As show in Figure 1-2, OU 1085 is comprised of three technical areas (TAs): TA-14, TA-67, and (former) TA-12. TA-14 lies on Three-Mile Mesa, west of all but the beginning of Three-Mile Canyon. TA-67 lies north of Three-Mile Canyon on Pajarito Mesa. TA-12 has been decommissioned and incorporated into TA-67 and TA-15 (OU 1086) (Figure1-5).

2.2 Operational History

Former TA-12, known as L-site, was constructed in 1945 for the Explosives (X Division). Original structures at the site included a trim building (C-12-001), control chamber (C-12-002), generator building (C-12-004), magazine (C-12-003), firing pit (12-001[b]); a junction box (C-12-005); and a road block. The principal structure was the belowground, steel-lined firing pit (12-001[a]) (Figure 1-4). The pit was used from 1945 to the mid-1950s. One test in the structure involved a 154-lb sphere of uranium (Anonymous, no date, 21-0004) other materials used included explosives, lead, and uranium-238 (DOE 1987, 0264). The burn site (12-002) (Figure 1-4) was used once to dispose of a one-half pound of explosive by burning.

An open section on the mesa east of the pit was used for several months as a firing site for explosive charges (12-001[b]). A 70-kg charge was once detonated at this firing site. A shop hutment, two magazines and an AC generator were installed for that project. The site was abandoned by X Division in April 1946 (LASL 1947, 21-0038). By 1951, TA-12 was operated by the explosives testing group GMX-2. The site was one of three for the 7N Program, in which 600 shots per month were fired (Anonymous, 21-0004).

In 1950, the Biomedical Group (H-4) constructed a bermed radiation test bunker and conducted experiments using a 1000-Ci radioactive lanthanum-140 source. Traces of a radioactive contaminant, strontium-90, were still detectable in 1966 when a radiological survey tested a telephone pole, a plastic tube, and a container for radioactive materials (Blackwell 1966, 21-0005). The control bunker (TA-12-8) (Figure 1-5), although decrepit, is still in place.

The site was abandoned in 1953. A radiological survey in 1959 indicated that all buildings were free of radioactive contamination (Blackwell 1959, 21-0002). A 1959 survey of vacated Laboratory structures indicated that the bermed area was contaminated with high explosives (HEs), although the presence of undetonated HEs was unlikely. Most of the structures were decontaminated and decommissioned (D&D) and burned in 1960.

In 1968 an acetylene gas gun was used for mortar-locator experiments. What appears to be remains of the experiment was found at the site during a recent field survey (DOE 1987, 0264].

As a result of the 1989 Laboratory redefinition of TA boundaries, former TA-12 was incorporated into TA-67 (LANL 1990, 0145). TA-67 was established in 1989 when the Laboratory redefined the technical area boundaries. The site is considered to be a buffer zone and has not been used for any Laboratory operations. It contains no SWMUs (LANL 1990, 0145).

TA-14, known as Q-site, was constructed in 1944 by X Division for close observation work on small explosive c arges. It included both open and closed firing chambers (LASL 1947, 21-0038). The site has always been used for the development and testing of explosives, including tests involving radioactive materials. Structures at the site include explosives magazines, a control building, and equipment boxes (Figure 1-6). TA-14 remains active with scheduled tests at both the firing area (14-001[g], Aggregate 4) and the Bullet Test Facility, a gun-firing site (14-001[f], Aggregate 3) (Figure 1-6). In 1952 the firing site was renovated. According to Engineering drawing ENG-R 129, many structures were removed and a new firing site was constructed.

2.3 Waste Management Practices

2.3.1 Past Waste Management Practices

Potential contaminants of concern (PCOCs) at TA-12 are ^{90}Sr and HEs. Radioactive lanthanum (^{140}La, $t_{1/2}$ = 40h) contaminated with ^{90}Sr was used for experiments at building 12-8 (Figure 1-5). Scrap HEs were burned on site, kerosene and excelsior (wood shavings) being used to sustain combustion (Anderson 1962, 21-0012). Upon D&D, whole structures were burned in place (LANL 1990, 0145). If a structure was contaminated with radionuclides, it was ultimately disposed of at MDA G.

TA-14 has a wider rnage of PCOCs, which include HEs and the HE-detonation products beryllium and lead (Schulte 1949, 21-0042). Uranium and radioactive lanthanum (TA-12) were also used. In the 1950s, a Es burning area was located east of TA-14-23. Buildings were also destroyed by burning (DOE 1987, 0264). Prior to burning, radioactively contaminated parts were removed and taken to MDA G (Gibbons 1973, 21-0031).

2.3.2 Current Waste Management Practices

Waste-generating operations at Q-site conform to Laboratory waste management policies as described in Administrative Requirements AR-1 through AR-6 of the Laboratory Environment, Safety, and Health Manual (ES&H) (LANL 1990, 0335). These requirements provide for the minimization, segregation, and disposal of mixed waste, low-level radioactive waste, chemical waste, hazardous waste, sanitary landfill waste, and transuranic (TRU) waste. These Laboratory waste policies are derived from and meet the requirements of appropriate DOE orders, RCRA, State of New Mexico Hazardous Waste Management regulations, and Laboratory practices.

2.4 Current Conditions at OU 1085

The old TA-12 site remains abandoned. The buildings have been removed, but earthen berms and the steel test pit (12-001[a]) remain (DOE, 1987, 0264). An unimproved road traverses the wooded mesa. TA-14 is an active site with scheduled explosives tests at the firing site (14-001[g], Aggregate 4). The complex at TA-14-34 (14-001[f], Aggregate 3) is used for a variety of experiments, including laser and gun tests. TA-67 is considered a buffer zone and is not used for Laboratory operations.

REFERENCES

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Blackwell, C. D., June 2, 1959. "Radiation Health Clearance of Surplus Laboratory Structures," Los Alamos Scientific Laboratory Memorandum LA59000997, Los Alamos, New Mexico. (Blackwell 1959, 21-0002)

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CHAPTER 3

ENVIRONMENTAL SETTING

3.0 ENVIRONMENTAL SETTING

The environmental setting of the Laboratory is described in detail in Subsection 2.5 of the IWP (LANL 1993, 1017). A discussion of the environmental setting for OU 1085 is presented in the following sections. When relevant to this RFI work plan, information contained within the IWP is sited. The site-specific information discussed focuses on that required to evaluate potential migration pathways and conceptual exposure models at OU 1085.

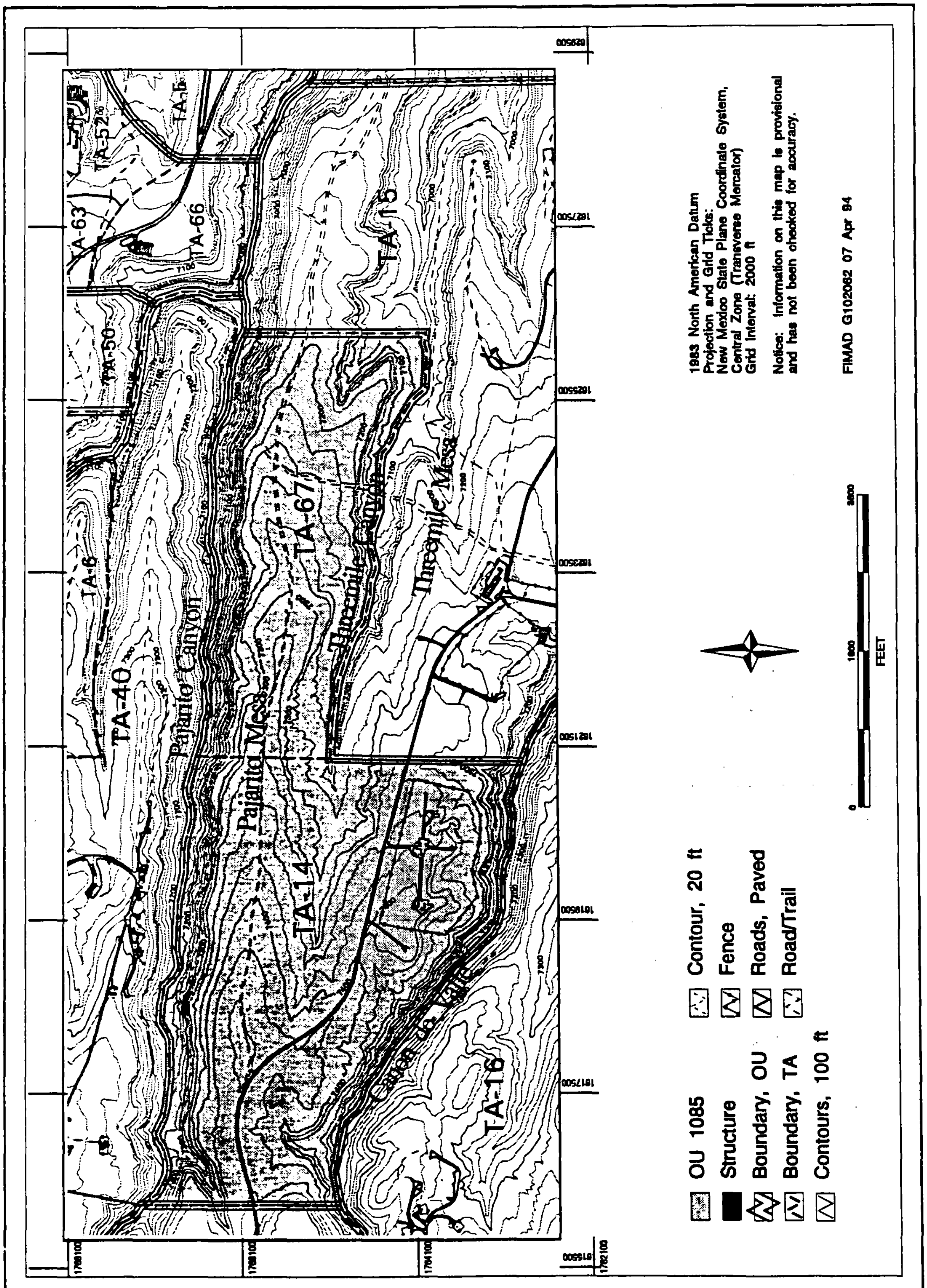
Subsections 3.1 through 3.5 of this chapter provide a foundation for the conceptual geologic/hydrologic model in Subsection 3.6. This model pictorially summarizes environmental factors that are likely to influence contaminant migration in OU 1085. This model, hence, is a framework for consideration of remediation alternatives (Chapters 4 and 5), conceptual exposure models (Chapters 4 and 5), and PRS-specific sampling plans (Chapter 5).

Chapter 2 of the IWP (LANL 1993, 1017) briefly covers regional data on surface water and groundwater quality, air quality, penetrating radiation levels, and chemical and radiation levels in soils when these data are required later in the RFI work plan. These data address environmental conditions beyond the immediate range of effects of TA-12 and TA-14 operations, but they may be needed to provide a basis against which site-specific data can be compared.

OU 1085-wide data needed to understand the behavior of hazardous contaminants in the environment will be addressed in Chapter 5. One goal of the PRS-specific sampling plans described in Chapter 5 is to identify the nature of environmental transport of hazardous contaminants in the three technical areas that constitute OU 1085 (TA-14 and TA-12, which is contained within TA-67 and TA-15). These results will be used to refine the risk-assessment models in an iterative fashion and may be used to define the nature and scope of Phase II investigation, voluntary corrective actions (VCAs) or corrective measures studies.

3.1 Physical Description

OU 1085 is located in the west-central portion of LANL. It is located on Pajarito and Three-Mile Mesas, east of the Jemez Mountains. The two technical areas that constitute OU 1085 lie at elevations ranging from 7200 ft at the east of TA-12 to 7500 ft at the western boundary of TA-14 (Figure 3-1). The canyon bottoms surrounding the OU range in elevation from 7300 ft to 7000 ft in Pajarito Canyon, 7200 ft to 7050 ft in Three-Mile Canyon, and 7300 ft to 7100 ft in Cañon de Valle.


TA-63
TA-66
TA-52
TA-15
TA-50
TA-6
TA-40
TA-67
TA-14
TA-16
Pajarito Canyon
Pajarito Mesa
Threemile Canyon
Threemile Mesa
Cañon de Valle
OU 1085
Structure
Boundary, OU
Boundary, TA
Contours, 100 ft
Contour, 20 ft
Fence
Roads, Paved
Road/Trail
1983 North American Datum
Projection and Grid Ticks:
New Mexico State Plane Coordinate System,
Central Zone (Transverse Mercator)
Grid Interval: 2000 ft
Notice: Information on this map is provisional and has not been checked for accuracy.
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OU 1085 AREA

OU 1085 is bounded on the west by TA-9, on the north by Pajarito Canyon, on the south and east by TA-15, and on the south by Cañon de Valle. Three-Mile Canyon begins in OU 1085, dividing TA-12 on the north from TA-15 on the south; TA-14 lies west of TA-12. The surface of the mesa, which contains the majority of PRSs in this OU, is relatively flat. Pajarito Canyon also drains TA-8, TA-9, TA-66, TA-46, and TA-15. Cañon de Valle also forms the southern boundary of TA-9 and TA-15 and the northern boundary of TA-16. Thus, sample contamination in these canyons may include contaminants from operations at these sites as well as TA-12 and TA-14.

Pajarito Canyon and Three-Mile Canyon merge east of TA-12. Pajarito Canyon continues eastward and joins the Rio Grande roughly 6 to 7 miles east of TA-12. Cañon de Valle is a tributary canyon to Water Canyon, which flows into the Rio Grande 6 to 7 miles from TA-14. The three canyons abutting the mesa tops within OU 1085 all have relatively steep walls; Pajarito Canyon is as much as 200 ft deep in the TA-12 area; Three-Mile Canyon reaches a depth of 100 ft; and Cañon de Valle cuts down more than 100 ft (Figure 3-1). Pajarito Canyon cuts the Bandelier Tuff along much of its length, the Cerros del Rio basalts in its eastern portion, and Tschicoma Formation dacites in its western portion. The other two canyons cut only the Tshirege Member of the Bandelier Tuff. Thus, natural metal background in the canyon drainages will reflect the variety of trace elements typical of volcanic tuffs, dacites, and basalts. Both Cañon de Valle and Pajarito Canyon are characterized by ephemeral and intermittent run-off of both snowmelt and rainwater. Occasionally such run-off reaches the Rio Grande from Pajarito Canyon. Smaller surface drainages on the mesa top are generally oriented north, south, or east, and feed the two larger OU-bounding canyons.

Aerial photographs of the TA-12 and TA-14 areas taken in September 1991 at a scale of (1:7200), and aerial orthophotographs (1:1200) with 2-ft contour resolution have recently been prepared for the site. This topographic map coverage should be adequate for the majority of investigations associated with this work plan.

3.2 Climate

Los Alamos County has a semiarid, temperate, mountain climate that is described in detail in (Bowen 1990, 0033) and in Chapter 2 of the IWP (LANL 1993, 1017).

3.3 Cultural And Biological Resources

Summaries of cultural and biological resources are provided in Appendices A and B.

3.4 Geology

This subsection provides OU-specific information regarding the geology of OU 1085.

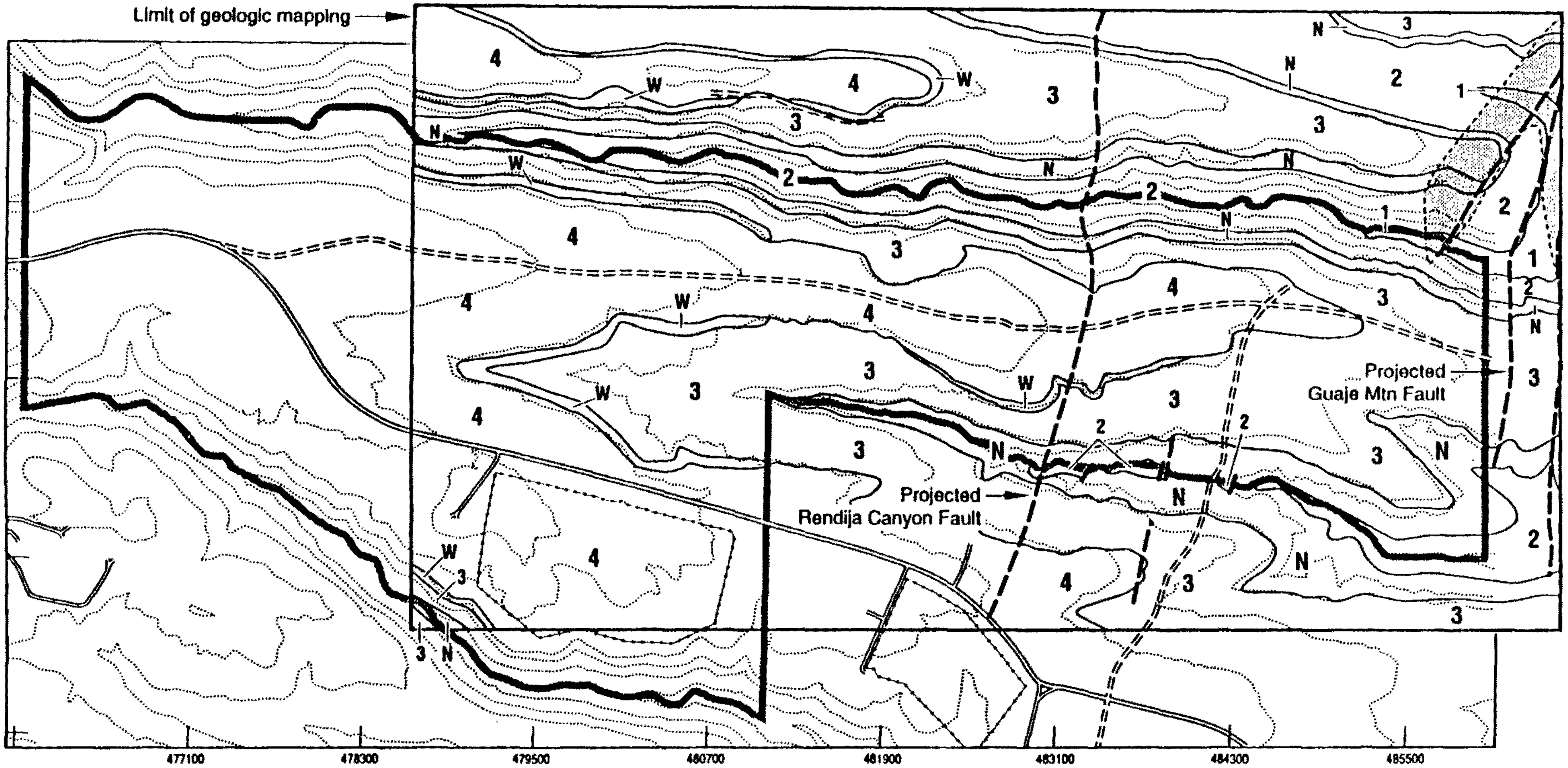
3.4.1 Bedrock Stratigraphy

The mesa surfaces of OU 1085 are immediately underlain by the Bandelier Tuff of Pleistocene age, which is exposed in a few places on the mesa tops and in canyon walls. Stratigraphic relationships within OU 1085 are inferred from mesa-top and canyon-side mapping (Figure 3-2). All subunits described below are based on the mapping of Vaniman and Wohletz (1990, 0541); unit nomenclature follows these workers. A typical section through Pajarito Mesa is shown in Figure 3-3.

The uppermost unit in the Tshirege Member of the Bandelier Tuff exposed within OU 1085 is Unit 4, which reaches a maximum thickness of 50 ft on Pajarito Mesa. It covers much of the west end of OU 1085 and thickens to the west. It is a sequence of stratified tuffs that include a massive, pumice-poor, nonwelded ignimbrite, a crystal-rich surge deposit characterized by cross-bedding, and a poorly stratified nonwelded ignimbrite (Broxton et al., no date, 21-0092). Unit 3 underlies much of OU 1085, particularly the eastern portions of the OU. It is a thick (up to 100 ft), massive, nonwelded to moderately welded, pumice-poor, vapor-phase altered ignimbrite (Broxton et al., no date, 21-0092). It forms the prominent cliffs that bound the mesa top areas of OU 1085. A 25 to 30 ft section of nonwelded tuff outcrops in the canyon wall of OU 1085 beneath Unit 3. It appears to have significantly higher porosities and permeabilities than the more welded units and may be a likely location for a perched aquifer. This nonwelded tuff is a pumice-poor, massive, vapor-phase altered ignimbrite (Broxton et al., no date, 21-0092). Unit 2, a massive, well-indurated, vapor-phase altered ignimbrite, occupies the base of the canyons. This unit is characterized by well-developed fractures (Broxton et al., no date, 21-0092; Vaniman and Wohletz, 1990, 0541). Additional details concerning the mineralogy and rock-characteristics of these units can be found in (Broxton et al., no date, 21-0092; Vaniman and Wohletz 1990, 0541).

3.4.2 Structure

Three large, near-vertical faults, the Frijoles segment of the Pajarito fault zone, the Guaje Mountain fault, and the Rendija Canyon fault have been mapped within or near OU 1085. The first, located due west of the western boundary of the Laboratory, is the largest segment of the Pajarito fault system in the Los Alamos area, with down-to-the-west displacement ranging up to 400 ft during the last 1.1 million years (Gardner and House 1987, 0110) (Figure 3-2). The Rendija Canyon and Guaje Mountain faults have surface evidence for down to the east



GEOLOGIC UNITS:

Paved road	W Welded
Unimproved road	N Nonwelded
Fence	1 Unit 1
OU 1085 boundary	2 Unit 2
Contour interval = 50 ft	3 Unit 3
Geologic unit contact	4 Unit 4

(W, N, 1–4: Tshirege Member Bandelier Tuff)

Zone of intense fracturing

Fault (dashed where uncertain)

Figure 3-2. Geologic map of OU 1085.

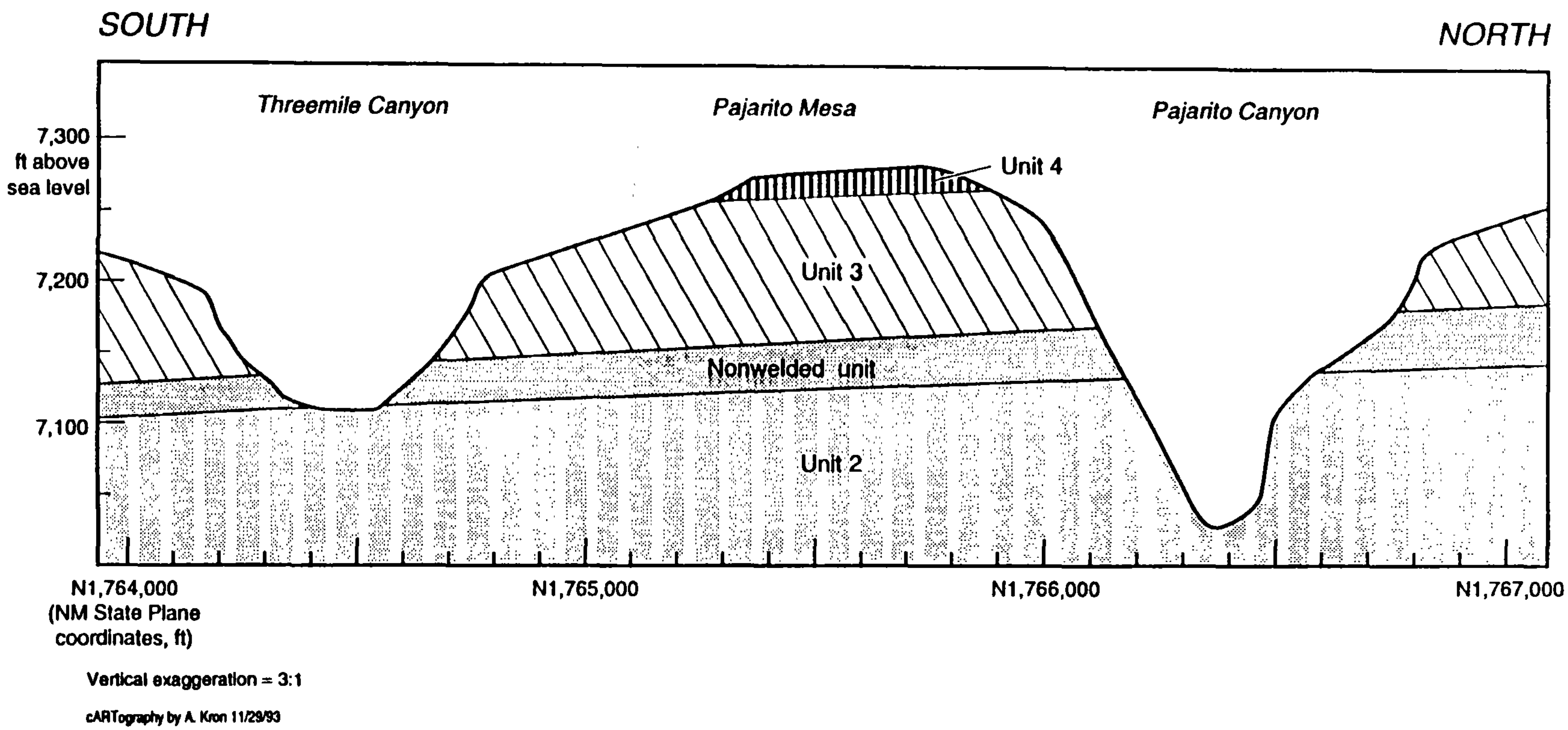


Figure 3-3. North-south cross section across Pajarito Mesa at study area PS-1 (modified from Broxton et al. 1993).

displacement north of OU 1085. They are inferred to pass through the operable unit within Pajarito Mesa (Figure 3-2).

Broad zones of intense fracturing superimposed on primary cooling joints are associated with major faults in the Los Alamos region (Vaniman and Wohletz 1990, 0541). A detailed study of fractures on the south wall of Pajarito Mesa was recently completed (Vaniman, no date, 21-0096). Vaniman found that observable offsets of tuff units were present near the west end of Pajarito Mesa. Fractures were also common in the area, with fracture densities decreasing from 75 "mesa-penetrating fractures" per 1000 ft toward the west to 40 per 1000 ft to the east (Vaniman, no date, 21-0096). Fracture orientations are generally concentrated around N15°E near the western end of Pajarito Mesa. Fracture orientations remained primarily NE toward the east of the mesa, but the orientations become more widely scattered (Vaniman, no date, 21-0096). Unlike cooling joints, such tectonic fractures are likely to cross flow units and may provide a deeply penetrating flow path for groundwater migration. More detailed information on fractures within OU 1085 is provided (Vaniman, no date, 21-0096).

3.4.3 Surficial Deposits

3.4.3.1 Alluvium and Colluvium

A general description of alluvial and colluvial deposits around the Laboratory is provided in the IWP, Subsection 2.6.1.6 (LANL 1993, 1017).

Surficial deposits on the plateau surface of OU 1085 consist of coarse-grained colluvium on steep hill slopes and along the bases of cliffs, finer-grained alluvial and colluvial sediments with a thin cover of eolian sediments on the flatter parts of mesa surfaces, and alluvial to colluvial fan deposits at the mouths of steeper drainages or on escarpments related to post-Bandelier faulting. Reneau (1993, 21-0094 and 1994, 21-0095) recently discovered mesa-top alluvial gravels on Pajarito Mesa. Because of this observation, he concludes that no significant vertical erosion of the mesa tops has occurred since the incision of Pajarito Canyon (at least 1 million years).

Deposits in the major canyons consist of colluvial materials on and at the base of cliffs and canyon walls, representing large volume mass wasting, and fluvial sediments deposited by intermittent streams along the axes of canyon floors.

3.4.3.2 Soil

The nature and thickness of soils at TA-14 and TA-67 (TA-12) may influence the transport of hazardous contaminants in the local environment. Soil mineralogy, permeability, grain size, organic content, and chemistry are all factors that may impede or enhance the movement and concentration of individual hazardous constituents within the operable unit.

Soils in Los Alamos County were mapped and described by Nyhan et al. (Nyhan et al., 1978, 0161). The soils were all formed in a semiarid climate and include material derived from Bandelier Tuff bedrock and eolian material. Table 3-1 and Figure 3-4 show the spatial distribution and nature of soils at TA-14 and TA-67 (Nyhan et al. 1978, 0161).

A wide variety of soil types occurs at TA-14 and TA-67 (Table 3-1). These include: Tocal very fine sandy loam, Pogna fine sandy loam, Frijoles very fine sandy loam, Hackroy sandy loam, Seaby loam, Nyjack loam, and Typic Eutroboralfs. These soil units transition into outcrops of Bandelier Tuff along the margins of the mesa tops. Soils are generally thicker in the western portions of OU 1085 (Figure 3-4).

Chapter 2 of the IWP (LANL 1993, 1017) states that an impermeable clay zone often forms at the soil-tuff interface on the Pajarito Plateau. This layer possibly provides an effective barrier to the movement of groundwater from the soil into the underlying tuff (Weir and Purtymun 1962, 0228; Abeele, Wheeler, and Burton 1981, 0009). However, disturbed areas, where soils have been scraped off and bedrock exposed, would not effectively seal off infiltration of surface waters into tuff.

3.4.3.3 Erosional Processes

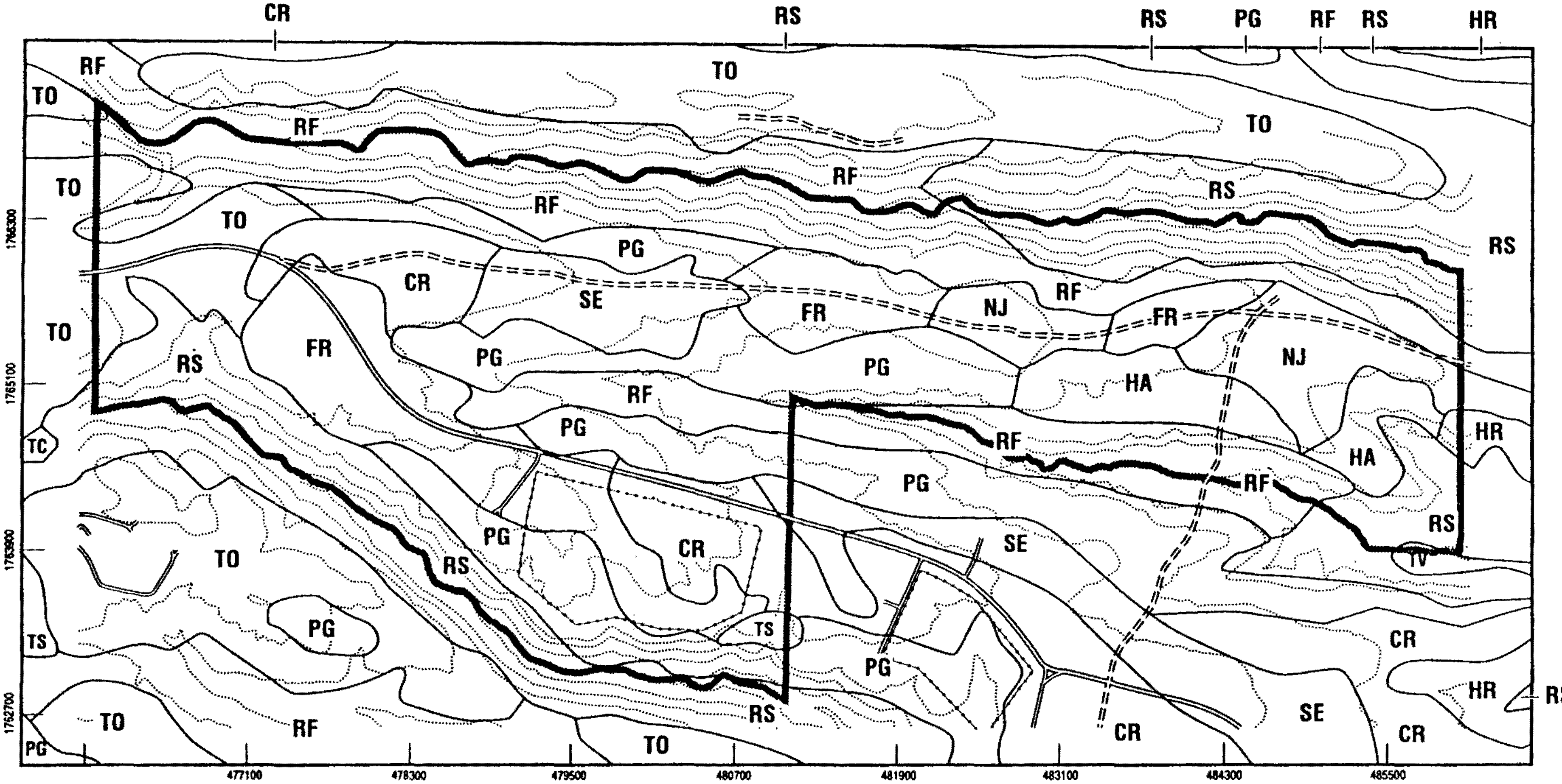
Erosion on the mesa tops in OU 1085 is caused primarily by shallow run-off on the relatively flat mesa surfaces, by deeper run-off in channels cut into the mesa surfaces, and by rockfalls and colluvial transport from the steep canyon walls. Erosion within the canyon bottoms occurs primarily because of channelized flow along stream courses on the canyon floors.

Reneau (1994, 21-0095) recently completed a study of erosional processes at OU 1085. Measurements of the width of Pajarito Canyon suggested minimum limiting average rates of cliff retreat of 0.71 ft per 1000 years at the east end of OU 1085. Reneau suggested that although the failure mechanism for landslides along the north rim of Pajarito Mesa was uncertain, the most likely possibilities were landslides with curved failure surfaces and mass wasting dominated by toppling failures. The south rim of Pajarito Mesa was dominated by small rockfalls consisting of fracture-bounded blocks of tuff. In both cases toppling of trees rooted in the fractured tuff may enhance mass wasting (Reneau, 1994, 21-0095). Reneau also identified an area of erosional instability centered on the projected extension of the Guaje Mountain fault zone (Figure 3-2).

TABLE 3-1

OU 1085 SOILS

ABBREVIATION	NAME	LOCATION	PERMEABILITY	WATER HOLDING	TYPICAL THICKNESS
TO	Tocal very fine sandy loam	Western end	Low/moderate	Low	28-36 cm
CR	Carjo loam	TA-14 eastern firing site	Moderate	Medium	51-102 cm
FR	Frijoles very fine sandy loam	TA-14 central firing site, TA-12 west of firing site	Very high in subsoil	Very low	46-152+ cm
PG	Pogna fine sandy loam	TA-14 western firing site	Moderate/high	Low	13-30 cm
NJ	Nyjack loam	TA-12 firing site	Moderate	Medium	50-120
HA	Hackroy sandy loam	TA-12	Low	Low	20-50



Sources: Nyhan et al. 1978 (0161) and FIMAD 8/18/93, G101294
Note: Information on this figure is provisional and has not been checked for accuracy.
Modified by: cARTography by A. Kron 4/8/94

Paved road	
Unimproved road	
Fence	
OU 1085 boundary	
Contour interval = 50 ft	
Soil unit contact	

SOIL TYPES:

CR	Carjo loam	SE	Seaby loam
FR	Frijoles very fine sandy loam	RF	Rock outcrop, frigid
HA	Hackroy sandy loam	RS	Rock outcrop, steep
HR	Hackroy rock outcrop complex	TO	Tocal very fine sandy loam
NJ	Nyjack loam	TC	Typic Eutroboralfs, clayey-skeletal
PG	Pogna fine sandy loam	TS	Typic Eutroboralfs, fine
		TV	Totavi gravelly loamy sand

0 500 1000 1500 2000 ft

N

Figure 3-4. Soil map of OU 1085.

Contaminants stored in sediments on mesa tops may be transported into the canyons, and potentially off-site, by large-scale run-off events on the mesa surfaces, or they may be carried in large masses of rock and debris as they slide down valley walls into the canyon bottoms. Contaminated sediments in the canyon bottoms are most likely to be transported off-site in major run-off events. Waste sites in OU 1085 most likely to be susceptible to off-site mobilization are those that lie close to the edges of mesas or near active channels in canyon bottoms.

3.5 Conceptual Hydrologic Model

The groundwater pathway is unlikely to be an important transport pathway at TA-12 or TA-14 because of the great depth to the main aquifer (>1000 ft) (LANL 1993, 1017). However, surface and vadose zone hydrology may strongly influence the stability and movement of contaminants in the area.

3.5.1 Surface Water Hydrology

Surface water run-off and infiltration into soil are the most important hydrologic transport pathways at OU 1085. HEs and uranium, the principal contaminants at TA-12 and TA-14, are weakly to moderately soluble (Layton et al., 1987, 15-16-447) and thus may be transported in surface water. Aspects of the surface hydrology at TA-12 and TA-14 that may be relevant to contaminant transport include:

- The location of pathways of surface water run-off and associated sediment deposition;
- Rates of soil erosion, transport, and sedimentation;
- The effects of operational disturbances on surface hydrology;
- The relative importance of surface run-off in contrast to infiltration as a transport pathway in different soil types;
- The solubility behavior of contaminants (particularly HEs and uranium) in surface water;
- The nature of interactions between soils and water-borne contaminants; and
- The ultimate fate of surface water at TA-12 and TA-14.

3.5.1.1 Surface Water Run-off

Surface water run-off is an effective means of transporting many contaminants, particularly highly soluble contaminants, in environmental media. Run-off can mobilize contaminants and transport them off-site or concentrate dispersed surficial contaminants through solution and reprecipitation or sorption processes. Surface water run-off from OU 1085 flows from ephemeral streams on the mesa tops into Cañon de Valle, Three-Mile Canyon, Pajarito Canyon, and ultimately into the Rio Grande, or: infiltrates downgradient. There is no conclusive evidence for the hydraulic connection of surface water and the regional aquifer at TA-14 or TA-67 (TA-12) (IWP, Chapter 2), although a connection may exist between discharge sinks in canyon bottoms and the main aquifer east of OU 1085 (LANL 1993, 1017). Permanent alluvial aquifers are not known in Cañon de Valle, Three-Mile Canyon, or Pajarito Canyons, but surface run-off may occasionally recharge short-lived alluvial systems.

As described in the IWP, the heaviest precipitation on the Pajarito Plateau occurs during summer thunderstorms. These thunderstorms can produce transient high discharge rates that may transport dissolved material, colloids, and contaminated sediments. Both these rain-induced events and snowmelt may yield ephemeral stream flows in the major canyons that could reach the Rio Grande.

No comprehensive study of surface run-off from the mesa tops and canyons constituting the surface watershed of the Pajarito Plateau has been completed.

Water quality data have been collected downstream from TA-12 and TA-14 in Pajarito and Water Canyons for the past 30 years. Water chemistry analyses over this period have generally shown that contaminant concentrations are below levels of concern (EPA, New Mexico Environment Department [NMED], and DOE standards) for uranium and other metals.

3.5.1.2 Surface Water Infiltration

Surface water infiltration is a potential mechanism for surface contaminants to move into subsurface soils and tuffs and eventually reach perched or regional aquifers. Surface water infiltration is considered to be a minor transport mechanism at the Laboratory because of the great depth to the regional aquifer, the high evaporative potential of the upper tuff, the likelihood of vegetative transpiration, and the resulting naturally low moisture content and high porosity of the tuffs (LANL 1993, 1017).

3.5.2 Hydrogeology

The hydrogeology of the Laboratory and the occurrence of surface water and groundwater are summarized in Subsection 2.6 of the IWP (LANL 1993, 1017). Canyon and mesa topography and the ash deposits of the Bandelier Tuff control the hydrogeology of OU 1085. The hydrology (occurrence and movement of water in surface and subsurface environments) of individual SWMUs in OU 1085 is controlled by the physiographic location of each SWMU in canyon bottoms, canyon rims, or mesa tops. The majority of OU 1085 SWMUs lie on the mesa tops; although a few SWMUs, such as SWMU 14-009, are located on the rims of the canyons. The following discussion presents site-specific information on the hydrologic conditions in Pajarito Canyon and on the mesa top of OU 1085.

3.5.2.1 Vadose Zone

The mesa top of OU 1085 overlies at least 700 ft of unsaturated Bandelier Tuff, interbedded epiclastic sediments and pumice falls, and underlying Puye Formation sediments. The hydrology of the mesa top vadose zone is discussed in Subsection 2.6.3 of the IWP (LANL 1993, 1017). In general, the IWP suggests that the Bandelier Tuff is saturated, only in very shallow and localized areas. The low moisture content and extensive thickness of unsaturated rock are believed to impede movement of fluids downward to the main aquifer (LANL 1993, 1017).

Hydrologic characteristics of unfractured Bandelier Tuff depend on degree of welding, with porosity and hydraulic conductivity generally decreasing with increased degree of welding. At Los Alamos, saturated hydraulic conductivity for a moderately welded tuff ranges from 0.1 to 1.7 ft/day and for a welded tuff, from 0.009 to 0.26 ft/day (Abeele, Wheeler, and Burton 1981, 0009). However, because fracture density is generally greatest in welded tuffs, saturated hydraulic conductivities are often highest in the welded parts of ash flow deposits (Crowe et al., 1978, 0041).

3.5.2.2 Alluvial Aquifers

Surface water in saturated alluvium within canyons is discussed in Subsection 2.6.4 of the IWP (LANL 1993, 1017). Surface water occurs primarily as ephemeral streams in the two major canyons adjacent to OU 1085, although perennial water flow occurs in parts of Cañon de Valle because of spring discharge and process water discharged from TA-16-260 and also in Pajarito Canyon and other buildings from spring discharge and other Laboratory operations. Stream flow moves downgradient into the alluvium for an unknown distance. Stream loss caused by infiltration into the underlying alluvium typically prevents water flow from discharging across the eastern boundary of the OU. During periods of voluminous stream run-off or snowmelt, surface flow may reach the Rio Grande. The possible existence of perennial aquifers in these canyons has not been investigated. Such aquifers occur in other canyons on the Pajarito Plateau (LANL 1993, 1017).

3.5.2.3 Perched Aquifer

Perched water may occur in epiclastic sediments and basalts in the Pajarito Plateau (IWP, Subsection 2.6.5) (LANL 1993, 1017). The possible nature and location of perched aquifers in and around OU 1085 are not known, they may be explored as part of the Phase II investigation.

3.5.2.4 Main Aquifer

The depth to the main aquifer at OU 1085 has not been determined. The hydrology of the main aquifer beneath the Pajarito Plateau is described in Subsection 2.6.6 of the IWP (LANL 1993, 1017). According to the IWP, the main aquifer is located primarily in the Santa Fe Group and Puye Formation at depths of several hundred to greater than 1000 ft below the mesa tops. Based on current knowledge of the hydrology of the Pajarito Plateau as reflected in the IWP, the potential for impact on the main aquifer or the municipal drinking water supply from the PRSs in OU 1085 is thought to be extremely low.

3.6 Conceptual Three-Dimensional Geologic/Hydrologic Model of OU 1085

A conceptual model for OU 1085 has been developed that is based on the discussion of environmental setting presented in Subsections 3.1 through 3.5 of this chapter. The conceptual model is presented in simplified diagrammatic form in Figure 3-5. The physical processes and major pathways included in the model are based on current knowledge of the OU environment and the types of PRSs present at OU 1085. The processes and pathways discussed below provide the basis for the PRS-specific conceptual models for potential contaminant releases presented in Chapters 4 and 5. The primary release mechanisms and migration pathways of concern are:

- surface run-off and sediment transport,
- erosion and surface exposure,
- infiltration and transport in the vadose zone, and
- atmospheric dispersal of particulates.

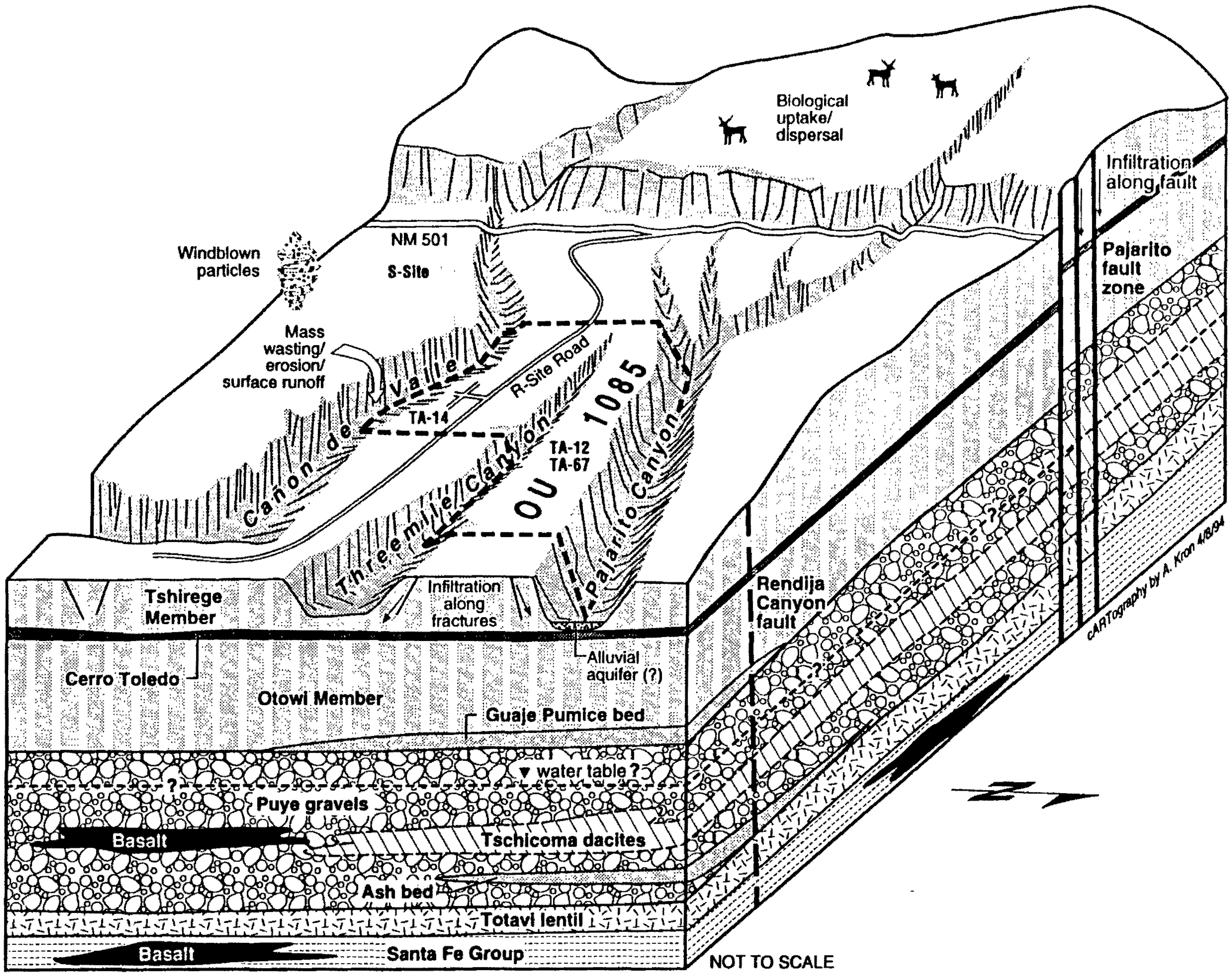


Figure 3-5. Conceptual hydrogeologic model of OU 1085.

These pathways are believed to provide the greatest potential for release and transport of contaminants to the environment at OU 1085. Additional release migration pathways of lesser concern are fluid transport via alluvial aquifers, perched water, springs, and seeps.

3.6.1 Surface Water Run-off and Sediment Transport

Surface water run-off and sediment transport are the migration pathways of greatest concern for transport of contaminants to off-site receptors. Surface water run-off is concentrated by natural topographic features and man-made diversions and then flows toward the canyons. A topographic low can cause run-off to pond and infiltrate into the mesa top or can facilitate sorption of contaminants onto finer-grained clay-rich sediments or organic particles. Contaminant transport by surface water run-off can occur in solution, transport of species sorbed on colloids, or with movement of heavier bedload sediments. Surface soil erosion and sediment transport are functions of soil properties and run-off intensity. Contaminants transported in run-off can disperse or concentrate in sediment traps in drainages. Erosion of drainage channels can disperse contaminants downgradient in a drainage.

3.6.2 Erosion and Surface Exposure

Soil erosion and mass wasting are long-term release mechanisms that may expose subsurface contaminants or allow water to access previously contained wastes. Erosion of surface soils depends on soil properties, vegetative cover, slope, exposure, intensity and frequency of precipitation, and seismic activity. Mass movements of rock from canyon walls is a discontinuous process that generally proceeds at a slow rate, but can they be an important mechanism for exposing subsurface contaminants located near canyon rims.

3.6.3 Infiltration and Transport in the Vadose Zone

Infiltration into surface soils and tuffs depends on the rates of precipitation and snowmelt, the amount of ponding, the nature of vegetation, in situ moisture content, and the hydraulic properties of soil and tuff. Fractures and faults may provide pathways for infiltration and release of contaminants into the shallow subsurface. Movement of liquids in soil and tuff is dominated by transient, unsaturated flow processes influenced by infiltration and evapotranspiration. The movement of contaminants by liquids in the unsaturated zone can occur in a free-liquid phase, in solution, or by adsorbed particles on colloids. Contaminants may be retarded as a result of adsorption on tuff or on organic material present in soil or alluvium. Precipitation of insoluble, contaminant-rich minerals may also retard the mobility of specific contaminants. Lateral flow or perched water may occur at unit contacts, between layers whose hydraulic properties differ, and in alluvial aquifers. Saturated lateral flow may discharge as springs or seeps on canyon walls or in canyon bottoms. Vapor phase movement in the unsaturated zone is a potentially important transport mechanism for volatile contaminants. Movement of contaminants in the vapor phase is influenced by concentration gradients, temperature gradients, density gradients, and/or air pressure gradients. Fractures may enhance liquid-phase or vapor-phase contaminant transport in the subsurface.

3.6.4 Atmospheric Dispersion

Wind entrainment of contaminated particulates, detonation or burn products, or volatile organic compounds is a potential pathway for atmospheric dispersal of contaminants. This dispersal mechanism is limited to detonation of HEs and combustion byproducts, surface contaminants, and vapors released from soil pore gases. Entrainment and deposition of particulates is controlled by soil properties, surface roughness, vegetative cover, terrain, and atmospheric conditions including wind speed, wind direction, and precipitation. Vapor dispersion is controlled by similar factors.

Not all release mechanisms and migration pathways discussed in this subsection are believed to be significant for all PRSs. The generic conceptual models in Chapter 4 and the PRS-specific conceptual models in Chapter 5 indicate for which PRSs these contaminant dispersal processes may operate.

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CHAPTER 4

TECHNICAL APPROACH

4.0 TECHNICAL APPROACH

This chapter describes the overall technical approach to Phase I of the OU 1085 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 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) (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).

There are sites with large pieces of contaminant (HE) on the surface, or embeded in surface soils. Samples containing such pieces would not pass screening action levels. It is also suspected that these sites would not meet target cancer risk assessment guidelines of 1 in a million risk or a noncancer hazard index of 1. Therefore, voluntary correction action is proposed for these sites. One site (12-001(a)) has sufficient historical information available to propose characterization for a health risk assessment.

This chapter is divided into ten sections. Section 4.1 discusses the rationale for aggregating PRSs into groups. Sections 4.2, 4.3, and 4.4 define and discuss SALs, VCAs, and baseline risk assessments, respectively. In Section 4.5, the decision analysis process to be applied to the PRSs is discussed. Section 4.6 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 4.7 discusses the potential remediation alternatives for OU 1085. Sections 4.8–4.10 discuss the sampling strategies, field operations, and analytical procedures that will be used. Finally, Section 4.11 discusses the mitigation of impacts on identified biological and cultural resources.

4.1 Aggregation of PRSs

The PRSs in OU 1085 have been aggregated into six groups: 1.) TA-12, inactive firing sites; 2.) TA-15, radioactive lanthanum site; 3.) TA-14, western area; 4.) TA-14, central area; 5.) TA-14, septic tank; and 6.) TA-14, east site and west magazine. Tables 1-3 and 1-4 in Chapter 1 lists the aggregates and related

PRSs and the subsections in Chapter 5 and 6 where these aggregates are presented. Detailed discussions of the rationales for aggregating PRSs are provided in the initial subsections (Subsection 5.x.1) for each aggregate.

4.2 Screening Action Levels

SALs are media-specific concentration levels for potential contaminants of concern (PCOCs) that have been derived through conservative health-based criteria (see Chapter 4 and Appendix J of the IWP—LANL 1993, 1017). In most cases, SALs for nonradiological potential contaminants of concern are calculated using the methodology described 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 based on a residential-use exposure scenario.

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 those of 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 if mandated, unless the VCA is undertaken as an emergency response. After resolution of comments, the VCA will be implemented.

4.4 Preliminary Baseline Risk Assessment

A baseline risk assessment is conducted when historical information makes further evaluation of the site expedient. The presence of contaminant concentrations above SALs may not in itself warrant corrective action for any of a number of reasons. SALs are compared with maximum sample concentrations. They are purposely set at very low levels, levels to which sensitive receptors could be exposed on a daily basis through all routes of exposure without appreciable risk of adverse effects during their lifetimes. Under a realistic site-specific exposure scenario, the potental health risks may be well within target risk guidelines.

Decisions about the site take into consideration the risk associated with identified constituents under actual or potentially realistic exposure scenarios based on expected land use. Among these risk-based decisions are determining whether corrective action is required, establishing target cleanup levels, and defining levels of concern for site monitoring. The risk calculation takes into account the proportional intake of contaminants by the receptor integrated over both the areas and duration of exposure. Therefore, a risk-based decision is most appropriately based on an estimate of the distribution of contamination throught an exposure unit, whose definition depends on the exposure scenario (e.g., residential, recreational, industrial) for which the risk is being calculted.

4.5 Decision Analysis

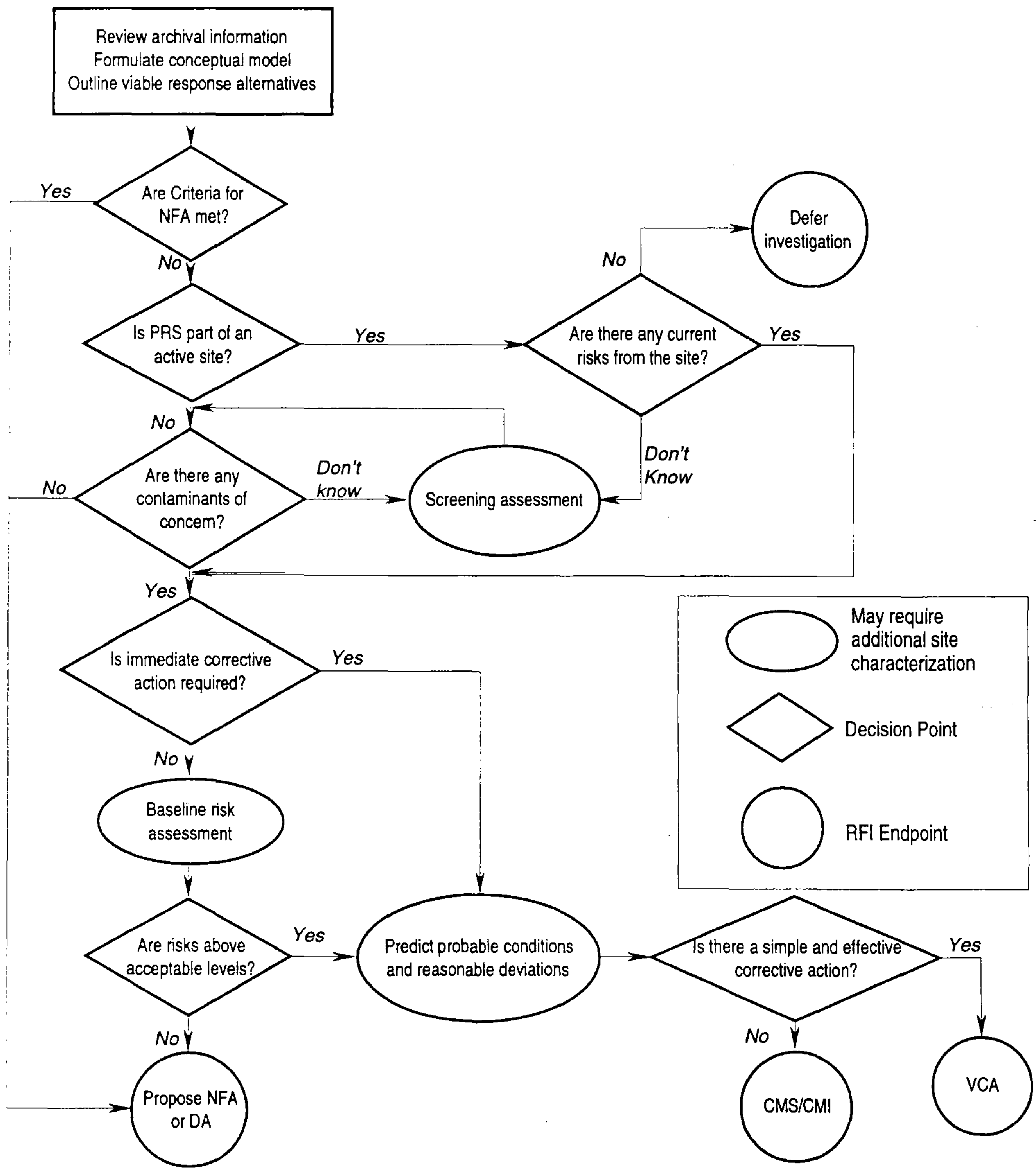
The decision logic on which RFI/CMS activities will be based is illustrated in Figure 4-1. The first step is to formulate a conceptual model for the site on the basis of archival information and the results of field reconnaissance work, which provide an initial list of potential contaminants of concern 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 1085 PRSs recommended for NFA or deferred investigation on the basis of archival information are discussed in Chapter 6.

For many PRSs in OU 1085, 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 and extent 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,

Figure 4-1

Decision logic for site investigations



through use of archival data and screening assessments, resources can be more efficiently and effectively channeled toward remediation of PRSs that do present hazards.

The two sampling strategies used in the RFI Phase I investigation are sampling for screening assessment and preliminary baseline-risk-assessment sampling. Sampling for screening assessment is the gathering of data for comparison with background concentration distributions and SALs; from these comparisons it can be determined whether any potential contaminants of concern 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 primarily sampling for screening assessment for the Phase I investigations at OU 1085. Preliminary baseline-risk-assessment sampling will be conducted at one site, PRS 12-001(a).

The maximum concentrations found of potential contaminants of concern 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 1085—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.

4.6 Conceptual Exposure Models for OU 1085

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 characterize accurately the PRSs; and determine whether the PRS poses a threat to human health or the environment. A conceptual model includes the following elements: identification of potential contaminants of concern; characterization of the release of contaminants of potential concern; determination of migratory pathways; and identification of potential human receptors (see Table 4-1).

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.

4.6.1 Generic Source Information

This section discusses the potential contaminants of concern at OU 1085 (see Table 4-2) and the physical, chemical, and radiological properties that influence their mobility and/or degradation in the environment.

4.6.1.1 Potentially Hazardous Chemicals

4.6.1.1.1 Explosive Constituents

Soils and sediments at the firing sites within Aggregates 1, 3, 4, and 6 may contain contaminants of concern from explosives operations. These include: 2,4,6-Trinitrotoluene [2,4,6-TNT]) (The residual parent explosive); 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 or degradation products of TNT); cyclotrimethylene-trinitramine [RDX] (a residual parent explosive or production impurity of HMX),

Table 4-1

Summary of Conceptual Model Elements

Pathways/Mechanisms	Concepts/Hypotheses
Historical Sources	Operations/processes that contributed to the creation of the PRS (e.g., storage areas).
PRS Release Mechanism	Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, leaching, dumping, or disposal into the environment.
Migration Pathway/ Conversion Mechanism	
Atmospheric particulate dispersion	Limited to contaminants in surface soils. Entrainment and deposition are controlled by soil properties, surface roughness, vegetative cover and terrain, and atmospheric conditions.
Volatilization	Some organic compounds volatilize 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 beyond the operable unit boundary within the aquifer or can result in discharge to surface water from springs and seeps.
Sediments	Constituents may be transported by surface runoff in solution, sorbed to suspended sediments, or as 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 in drainages. Erosion of drainage channels can extend the area of contaminant dispersal. Surface runoff carried into the canyons may infiltrate into sediments of channel alluvium.
Infiltration (percolation)	The degree of infiltration into surface soils depends on the rate of precipitation or snowmelt, antecedent soil/water status, depth of soil, and soil hydraulic properties. Infiltration into tuff depends on the unsaturated flow properties of the tuff. Joints and fractures in the tuff may provide additional pathways for infiltration to enter the 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 4-1 (concluded)

Summary of Conceptual Model Elements

Pathways/Mechanism	Concepts/Hypotheses
Potential Release Mechanism (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 depositing contaminants on plants which are then eaten 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 Route	
Inhalation	Vapors, aerosols, and particulates (including dust) can be inhaled. Physical and chemical properties of airborne contaminants influence the degree of retention in the body after being inhaled.
Ingestion	Contaminants may be ingested along with soil, water, food, and/or dust.
Direct contact	Some contaminants will absorb through the skin when in contact with contaminated surfaces of soil, tuff, or rubble or with contaminated surface water or sediments. 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 4-2

Potential Contaminants Of Concern at OU 1085

POTENTIAL CONTAMINANTS OF CONCERN	LAB METHOD[a]	LAB PQL (ppm)[b]	MOBILE LAB METHOD	MOBILE LAB PQL (ppm)[c]	FIELD SCREEN METHOD	FIELD SCREEN PQL (ppm)[d]	LANL BACK-GROUND IN SOIL (ppm)[e]	SAL IN SOIL (ppm)[e,f]
INORGANICS								
Barium	6010	0.2	XRF	10	LIBS	<100	125–829[h]	5600
Beryllium	6010	0.03			LIBS	0.1	1.0–4.4 [g]	0.16
Cadmium	6010	0.4	XRF	2			1.2–1.7 [g]	80
Chromium	6010	0.7	XRF	8	LIBS	2	2.03–71.07[g]	400(VI)
Copper	6010	0.6	XRF	3			2–18[h]	3000
Cyanide	9010	0.05					<1	1600
Lead	6010	4.2	XRF	10	LIBS	2	18–56[g]	500
Silver	6010		XRF		LIBS	1	1.7–2.9	400
HIGH EXPLOSIVES/DEGRADATION PRODUCTS								
2,4-DNT	8330	0.25	GC/FID	1			0	1
2,6-DNT	8330	0.26	GC/FID	1			0	1
HMX	8330	2.2			HE spot	100	0	4000
RDX	8330	1.0			HE spot	100	0	64
Tetryl	8330	0.65	XRF	15			0	800
1,3,5-TNB	8330	0.25					0	4
2,4,6-TNT	8330	0.25			HE spot	100	0	40
RADIONUCLIDES								
Strontium-90	β spec		gross β		gross β		0.03–1.0[i]	8.9 pCi/g
Uranium-235	α spec	0.05 pCi/g	gross α/β	25 pCi/g	Phoswich	35 pCi/g	–	18 pCi/g
Uranium-238	α spec	0.05 pCi/g	gross α/β	25 pCi/g	Phoswich	35 pCi/g	–	59 pCi/g

a SW 846 Method unless otherwise indicated.
b Method detection limits for EPA methods are taken directly from those listed in the appropriate SW 846 method or from the QAPjP.
c Estimated by CST-9, the Laboratory Environmental Analytical Chemistry Group.
d HMX and RDX estimated by Engineering and Information Resources. TNT from Baytos 1991.
e pCi/g for radionuclides
f SALs from IWP Appendix J (LANL 1993).
g Duffy and Longmire 1993.
h Ferenbaugh et al. 1990, 0099.
h Purtymun et al. 1987, 0211.

and cyclotetramethylenetetranitramine [HMX] (a residual parent explosive or production impurity of RDX). Tetryl [2,4,6-trinitrophenylmethylnitramine] may also have been used. 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 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).

4.6.1.1.2 Inorganic Constituents

Inorganic constituents possibly present at OU 1085 may also be traced to activities at firing sites., such as initiator development shots and initiator tests in which guns were fired into soil berms or into steel plates. Inorganic constituents may also be present in septic systems (Aggregate 5).

The constituents that may be present at OU 1085 are listed below, with a summary of the important factors affecting their mobility. In general, because soil conditions at OU 1085 are expected to be those associated with low mobility, such constituents should be found in soil near the point of release.

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.

Chromium. Chromium III is the most predominant form of chromium in the environment. Chromium VI is most often found in the aerobic zone of soils near the soil surface. Chromium VI is readily oxidized to Chromium III in the presence of moisture, oxygen, manganese dioxide, and low amounts of oxidizable organic substances. In deeper anaerobic soils, Chromium VI is reduced by sulfur and iron ions to Chromium III. The reduction of Chromium VI is facilitated in soils with low pH. Chromium mobility is enhanced in soils with high pH.

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).

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).

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).

4.6.1.1.3 Organic Constituents

At OU 1085, volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) may have been released to the environment if leaks or spills occurred from product storage areas (C-12-005, Aggregate 1), sumps (14-010 in Aggregate 2 and 14-006 in Aggregate 3), and septic systems (Aggregate 5). 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 increases, as solubility increases, 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 1085, which consist of 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.

4.6.1.2 Radionuclides

The radioactive contaminants of concern potentially present at OU 1085 includes uranium-235 (from natural uranium), depleted uranium (uranium-238), and strontium-90. The amount of a radionuclide that may be onsite depends on the original concentration released, the half-life, and the parent-daughter relationships. All of these radionuclides have long half-lives and are likely to be present on site.

The ingrowth of radioactive daughter products should also be considered. All of the immediate daughter products of these radionuclides are themselves radioactive. For instance, yttrium-90, the daughter of strontium-90, decays rapidly ($t_{1/2}$ = 64 hours) to stable zirconium-90, yet the nuclide persists in "secular equilibrium" with and persists as long as the parent ^{90}Sr ($t_{1/2}$ = 29.7 years). The radiological risk from long-lived actinides such as natural and depleted uranium ($t_{1/2}$ = 4.47 billion years), which have themselves low specific activities, is dominated by the ingrowth of highly radioactive and bioactive (i.e., long *biological* half-lives) daughter products such as radon-222 ($t_{1/2}$ = 3.8 days), radon-219 ($t_{1/2}$ = 4 sec) and radium-226 ($t_{1/2}$ = 1600 years). However, because these daughters are intrinsically mixed with the parent uranium—with the exception of evolution of gaseous radon from nonmetallic or finely divided uranium—removal or reduction of the source term, in this case the uranium or strontium contamination, effectively eliminates the radiological risk.

4.6.2 Potential Environmental Pathways

Chemical or radionuclide contaminants of potential concern at OU 1085 may have been released to the environment through tests at firing sites, burning in disposal operations, spills or leaks at storage areas, and discharges or leaks from sumps or septic 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 4.8 (and, by extension, the sampling plans presented in Chapter 5).

4.6.2.1 Surface Transport

The PRSs in OU 1085 are located either on Pajarito or Threemile Mesas. Active erosional processes on the Pajarito Plateau are addressed in Section 2.6.1.6 of the IWP (LANL 1993, 1017). At OU 1085, episodic periods of snowmelt and storm-water runoff can produce significant erosion, sediment transport, and deposition. Sediment accumulations exceeding 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, and burning disposal sites (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 1085. On the mesa top 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 either Threemile or Pajarito 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 cation-exchange capacity 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, because the coarser fractions make up the bulk of total soil mass in canyon alluvium, the greatest adsorbed constituent mass is associated with these larger fractions. 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 1085 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.

4.6.2.2 Atmospheric Transport

PRS 14-005 in Aggregate 3 (an open HE-incinerator) may release constituents to the air during burn operations. However, this interim status open burn/open detonation treatment unit is included in the Laboaratory's RCRA Part B Permit Application: Its operational releases to the environment are currently permitted. None of the other PRSs within OU 1085 consist of or contain air-emission facilities. 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. Several of the PRS—primarily the firing sites—are expected to have contaminated surface soil that could be eroded by the wind.

4.6.2.3 Subsurface Transport in the Vadose Zone

The thickness of the unsaturated zone beneath OU 1085 suggests that migration of contaminants from the surface to the main aquifer is unlikely. Refer to Subsection 2.6.2.3.3 of the IWP for a discussion of the hydrology of the main aquifer beneath OU 1085. Groundwater transport in the main aquifer will, therefore, not be considered a viable transport pathway in this stage of the RFI. If the results of Phase I of the RFI indicate that contaminant migration has occurred, this decision will be reevaluated.

Perched water, however, may be present in OU 1085. Potential contaminant movement into perched water and through fractures or faults in the subsurface is possible subsequent to infiltration or leaching into the vadose zone. Perched water is not likely to be a pathway of major concern. However, this pathway may be considered during Phase II investigations if the subsurface soil is shown to be contaminated during Phase I RFI investigations. Currently, there are no wells on site that are used as a source of drinking water.

4.6.3 Potential Impacts

Because OU 1085 is currently used for Laboratory operations, onsite workers represent the only potentially exposed population at the present time. To identify the presence of potential contaminants of concern 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 potential contaminants of concern 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. For one PRS, a VCA will be undertaken using appropriate cleanup levels that 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 (UCL) on arithmetic average concentration of potential contaminants of concern in exposure areas, either surface or subsurface soils, is sufficient to determine receptor exposures.

When a baseline risk assessment is conducted, the appropriate land-use scenario will be determined and used as input. For the foreseeable future, land use at OU 1085 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 1085 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]) 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 4-1).

4.7 Potential Response Actions

Table 4-3 summarizes the potential response actions for each PRS aggregate. Remediation alternatives must achieve acceptable risk levels; however, choosing between alternatives that meet human health risk requirements will be based on factors such as ecological impact, cost, regulatory concerns (in addition to risk), impact on Laboratory operations, socioeconomic impacts, and public concern (Appendix I, IWP) (LANL 1993, 1017); variations in the previously mentioned parameters may mandate different response actions for PRSs containing essentially identical contamination characteristics. Note that all actions refer to potential or known surface soil problems that represent the contaminants of greatest concern at the site. Subsurface contaminants could require other technologies (e.g., steam injection for vadose zone contaminants). 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.

4.7.1 No Further Action

The OU 1085 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 is presents no significant health, safety, or other type of risk, is an approved accumulation area; or will be addressed within another PRS).

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. The PRS is an approved accumulation area currently regulated under 40 CFR 262, Standards Applicable to Generators of Hazardous Waste. Releases will be cleaned up immediately in accordance with the Laboratory's Contingency Plan, Spill Prevention Countermeasures and Control Plan, and/or administrative requirements.

Criterion 3. The PRS will be addressed within another PRS.

Table 4-3
Potential Response Actions for Each PRS Aggregate*

			Removal/ Treatment								
Subsection	PRS Description	Action or Deferred Action	Hazardous Only	Radioactive Only	Mixed Waste	Incineration/Removal	Decon/ Removal	Conditional Cap/ Monitor	In-Stream Barriers	Access Restriction	In Situ Bioremediation
5.1	Firing site at TA-12	X	X	X	X		X			X	
5.2	Radioactive lanthanum site at TA-12	X	X	X	X		X			X	
5.3	Western area at TA-14	X						X	X	X	
5.4	Central area at TA-14	X						X	X	X	
5.5	Septic tank at TA-14	X	X	X	X		X			X	
5.6	East site and west magazine	X	X	X	X		X			X	

* Note that this table is not meant to be all-inclusive; selection of the preferred response action will ultimately be based on future land use scenarios, risk analysis and other factors as mentioned in Section 4.4

4.7.2 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. This remedy 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.

4.7.3 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 4.7.2.

4.7.4 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.

4.7.5 *In situ* Remediation

While bioremediation of HE is a promising *in situ* remediation option for some PRSs in OU 1085, existing data on HE contamination do not provide enough information to decide if it is a feasible alternative. At the time of actual field remediation, all *in situ* options for all PCOCs will be evaluated for applicability.

4.8 Sampling Strategies for PRS Aggregates

Sampling strategies for OU 1085 aggregates are summarized in Table 4-4.

4.8.1 Sampling for Screening Assessment

The premise of sampling for screening assessment is that samples can be taken that represent the maximum contaminant concentration in a PRS. Sample locations are biased either by knowledge of the physical process responsible for the potential contaminant distribution in space (or time) or by preliminary field screening and/or mobile laboratory methods. If field screening is used to select sample locations, then it is critical that methods be available for all potential contaminants or that a smaller set of potential contaminants can be used as surrogates for the remaining PCOCs. In the OU 1085 RFI, knowledge of the physical process responsible for the potential contaminant distribution is generally used to guide the selection of biased samples. for screening assessment.

Screening assessment sampling data will provide an estimate of the proportion of the site that exhibits concentrations that could exceed SALs. These measured values will be compared to SALs (1993 IWP), which are based on a conservative residential exposure scenario.

Screening assessment sampling results could also be used in support of a baseline risk assessment. Data from neighboring PRSs may be combined into a single baseline risk assessment, which is possible if

Table 4-4

Sampling Strategies Used in OU 1085 Aggregates

SUBSECTION	AGGREGATE DESCRIPTION	SCREENING ASSESSMENT SAMPLING	BASELINE RISK ASSESSMENT SAMPLING	VOLUNTARY CORRECTIVE ACTION SAMPLING
5.1	Firing site at TA-12	X	X	X
5.2	Radioactive lanthanum site at TA-12	X		
5.3	Western area at TA-14	X		
5.4	Central area at TA-14	X		
5.5	Septic tank at TA-14	X		
5.6	East site and west magazine	X		

these PRSs fall within an exposure area for the risk scenario and the list of COCs is similar. It is important to note that use of positively-biased data creates a conservative risk assessment, but also is one step closer to a representative risk assessment as compared with the assumptions used to derive the SALs.

The portion of the field sample that is submitted for laboratory analysis will also be biased by field survey or mobile laboratory results. Thus, sampling for screening assessment may have two levels of biasing which will increase the chance of sampling concentrations that may exceed SALs. In addition, subsurface borings (>12 in. length) will often be field screened for potential contaminants (e.g., radioactivity, HEs, volatile organics, metals) for health and safety purposes.

For some screening assessment surveys, the number of samples is based on quantitative statements of error tolerances. These are stated as the desired probability of detecting potential contamination when a certain percentage of the site is expected to be contaminated. For example, the decision maker may state that he or she wants to detect contaminants above SALs at least 90% of the time, if 25% of the site is known to be contaminated from knowledge of process. The binomial presence/absence sampling model (also known as the "nomogram" approach in the IWP) supplies the number of independent analyses of the PRS that must be taken to meet this performance goal (see Appendix H, IWP) (LANL 1993, 1017) For the above example, nine independent analyses are required to meet the decision maker's uncertainty tolerances. As noted above, these samples will be biased by field screening and do not assume a grid sampling pattern. The derivation of the binomial presence/absence sampling approach is given in Appendix H of the IWP (LANL 1993, 1017). The screening assessment sampling approach uses biasing techniques to increase the probability that the samples sent for laboratory analysis represent the maximum for a PRS. This biasing provides a probability statement that is conservative (i.e., the probability of detecting contamination is greater than 90%).

False negative errors are controlled in screening assessment surveys, but false positive errors are not controlled. However, the consequences of a false negative decision are more serious (propose NFA for a contaminated PRS) than are the consequences of a false positive error (collect additional data). Screening assessment sampling is most appropriate where there is reliable historical or archival data that indicate that the PRS is not known to be a problem (a true negative) and biased sampling is possible. For PRSs where it is likely that potential contaminants are above SALs, then baseline risk assessment sampling is more appropriate.

4.8.2 Baseline Risk Assessment Sampling

Baseline risk assessment sampling is recommended for PRSs where archival data or existing analytical data indicate that PCOCs are likely to be above SALs. The main difference is that in addition to providing data for a screening assessment, these data must be suitable for a baseline risk assessment. Data used in a baseline risk assessment must be representative of the heterogeneity within the exposure area and have adequate quality assurance (QA)/quality control (QC) measures. The absolute minimum number of samples that are adequate for a baseline risk assessment is three laboratory analyses, but the actual number for any PRS is based on the heterogeneity of the PCOCs and the exposure scenario. Field screening or mobile laboratory results may help determine the spatial or temporal extent of the potential contaminants, but these data will not be used to bias sampling.

The most important difference between baseline risk assessment sampling and sampling for screening assessment is the lack of biasing in the baseline risk assessment sampling, which yields a set of samples that is more representative of the exposure scenario. The likely exposure scenarios for these PRSs or PRS aggregates are a construction worker or recreational user scenario. A construction worker excavation scenario assumes that exposure occurs from the average concentration in 5-ft-depth increments. Thus, the sample should be collected to represent the average concentration in a 5-ft soil core.

A statistically based sampling design should be developed for baseline risk assessment surveys. Key design inputs for a statistically based survey are the spatial variation of the PCOCs and the laboratory measurement performance for these PCOCs. In some cases, such information for the PCOCs and the PRS will not be available, so professional judgement will be used to design the baseline risk assessment survey. All baseline risk assessment surveys will include a sufficient amount of QA/QC so that these design inputs will be known and a *post-hoc* assessment of data sufficiency can be made.

4.8.3 Voluntary Corrective Action Sampling

VCA sampling results will not be used in a screening assessment. The purpose of VCA sampling is to define the extent of contamination and to collect other information to guide site remediation. Media characteristics (e.g., organic material content) and the lists of COCs are important factors used to guide remediation. Thus, VCA sampling plans will vary based on the extent of the historical information on the PCOCs and other site characteristics. The verification sampling (during and postremediation) is not considered to be part of VCA sampling; such sampling is needed to ensure completion of the VCA and will be described in the VCA plan.

4.8.4 Phase II Investigations

For OU 1085 PRSs where no contaminants of concern are found during Phase I investigations, of proposal of NFA will be recommended. A Phase II investigation will be required for any PRS where contaminants of concern exceeding SALs or background levels 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.

4.9 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).

4.9.1 Field Surveys

Field surveys, which help identify sampling locations, include radiological surveys, land surveys, and geomorphic surveys. During Phase I, samples will be field-surveyed for radioactivity and HE. 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 survey 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 potential contaminants of concern, the number and/or types of laboratory analyses may be modified.

4.9.1.1 Radiological Surveys

Radiological surveys will be used for PRSs at which radionuclides may be present, to quickly pinpoint areas of potential contamination for biased sampling for screening assessment. 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 or a long-range alpha detector (LRAD), gross beta-gamma by means of a hand-held Geiger-Mueller detector (or other appropriate detector) and a rate meter.

4.9.1.2 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, 0688).

Technical personnel carrying out land surveys at OU 1085 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).

4.9.1.4 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 based on which specific sampling locations can be selected. Guidance for conducting geomorphic surveys is contained in LANL-ER-SOP-03.08 (LANL 1993, 0875).

4.9.2 Sampling of Soils and Sediments

The Phase I sampling activities for OU 1085 PRSs will include collection of surface and subsurface soil and sediment samples.

Soil samples will be collected from the locations judged most likely to contain any potential contaminants of concern from operations at the PRS, and sediment samples will be collected from catchment areas receiving runoff from the PRS.

The following SOPs will be used for sample collection:

- 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

Quality control (QC) samples will also be collected, to ensure that the quality objectives specified in the Quality Assurance Project Plan (QAPP, 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.

4.9.2.1 Field Quality Assessment Samples

The purpose of collecting field quality assessment samples is to quantify the performance of a sampling technique (surface samples taken by a hand auger, boreholes taken by a diamond drill, etc.). Thus, adequate data should be collected within OU 1085 to permit evaluation of each sampling method. Many kinds of quality assessment samples can be collected (e.g., collocated samples, homogenate subsamples, field duplicates), and the type and number of these samples depends on the major source of variation in the sample collection process. The implementation plan for OU 1085 will use guidance in the IWP (Appendix H, section 7.0; LANL IWP 1993, 1017) and survey-specific requirements in determining the number and type of field quality assessment samples. A brief discussion of the types of field quality assessment samples proposed in sampling for screening assessment and baseline risk assessment surveys is presented below.

Screening assessment sampling surveys usually involve collecting discrete samples from the surface or a segment of a soil core. These samples are selected by field screening or judgment to increase the probability the sample concentrations will be found that exceed SALs. Quality assessment samples will be taken at random to quantify the effectiveness of the biasing (within the PRS or in the soil core). Another quality assessment investment is to collect collocated samples. Collocated samples help determine the local variation in PCOCs, which is important to know when designin the statistical survey. A roughly equal number of quality assessment samples for evaluating the biasing procedure and for collocated samples will be allocated.

Material that is representative of the risk scenario will be collected during the baseline risk assessment surveys. In some cases, samples will be homogenized in the field before being submitted to the analytical laboratory. The largest source of variation is usually from field sample preparation (homogenizing), which indicates that the best investment in field quality assessment for baseline risk assessment surveys is the collection of additional subsamples of the homogenate. Collocated samples will also be collected, but the desired ratio is three additional subsamples for every one additional collocated sample. The rationale for this investment is that field quality assessment information for collocated samples will be collected in the screening assessment surveys, and that sample homogenization is expected to contribute an order of magnitude more variation to the sampling process than does local spatial variation of PCOCs.

4.10 Recordkeeping and Field Logs

All records generated by OU 1085 field investigations will be processed and archived in accordance with the Records Management Plan presented in Annex IV of the IWP (LANL 1993, 1017). Records generated during field activities will be documented in the field log. Records documenting activities occurring after samples have been shipped from the field to the analytical laboratory, including laboratory analyses, laboratory analytical results, data validation, data analysis, and preparation of the RFI Report, will be archived in accordance with the Records Management Plan.

A field log will be maintained during the sampling program. The log will document all field activities, including the sampling activity; record the information obtained from the field screening instrumentation; identify the procedures used in sampling and sample site selection; identify the personnel involved; and record any other information pertinent to the sampling process and to the quality of the results. Field logs maintained by individual field team members will be consolidated into a master log at the end of each major sampling activity.

The completed field log will document the implementation of this work plan. Most importantly, it will document the site-specific decisions of the field team leader required under the phased approach presented in this plan, as well as any modifications to the plan required to address unanticipated site conditions. Because sampling and site characterization are essentially processes of discovery, minor modifications to the sampling plan and to its implementation procedures may occur. As a vehicle for documentation, the field log will be written to provide sufficiently comprehensive descriptions of the sampling activities and their rationale so that modifications to the work plan are not expected to be needed.

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CHAPTER 5

SAMPLING AND ANALYSIS PLANS

5.0 Sampling and Analyses Plans for Aggregates at TA-12 and TA-14

All PRSs in OU 1085 will be evaluated according to the decision process presented and discussed in Chapter 4. In Chapter 5 we address those PRSs and aggregates that remain to be evaluated and for which sampling and analysis plans must be developed.

Table 5-1 shows the PRSs for which sampling and analysis plans have been developed. In addition, the table shows all the PRSs, including those recommended for DA and NFA. PRSs recommended for NFA are discussed in Chapter 6, while those PRSs recommended for DA are discussed with their associated aggregates in Chapter 5.

The PRSs have been divided into six aggregates determined for the most part, by geographical location and occasionally (as in Aggregate 6) by the function of the PRS. The locations of the aggregates are shown in Figure 1-3 and 1-4.

The following sections of Chapter 5 discuss the individual aggregates, describe the individual PRSs, and provide the rationale for the sampling plans or recommendation for DA, where appropriate.

5.0.1 POTENTIAL RELEASE SITES RECOMMENDED FOR NO CURRENT RCRA FACILITY INVESTIGATION WITHOUT FURTHER CHARACTERIZATION

The purpose of this section is to identify those potential release sites (PRSs) that do not require a current RFI. All PRSs covered in this chapter are recommended for investigation or DA. The locations of these PRSs are shown in Figures 1-3 and 1-4. To this end, a four-step evaluation criteria for DA following archival investigation was developed and is described in Subsection 4.1 of Appendix I in the 1993 WP (LANL 1993, 1017). Based on the criteria, the PRSs are recommended for either:

- DA, resulting in deferred characterization until the closure of the interim status unit under the Closure and Post Closure Plan in the RCRA Part B permit application; or,

- DA, resulting in deferred characterization (after an initial sampling campaign to investigate potential off-site migration) until the site is decommissioned if the PRS is an active operation, or is intimately associated with an active operation that presents no current human health or environmental risk

Table 5-1

AGGREGATE	INVESTIGATE PRSs			NO ACTION PRSs			
				Deferred Action		No Further Action	
	Work Plan Section	SWMUs	AOCs	Work Plan Section	PRS	Work Plan Section	PRS
1 (TA-12: Inactive Firing Site)	5.1	12-001(a) 12-001(b)	C-12-001 C-12-002 C-12-003 C-12-004 C-12-005			6.2.4.1 6.2.4.2	12-002 12-003
2 (TA-12: Radioactive Lanthanum Site)	5.2	12-004(a) 12-004(b)				6.2.2	C-12-006
3 (TA-14: Western Area)	5.3	Site wide sampling to determine possible migration of contaminants		5.3.7	14-001(f) 14-002(a,b,f) 14-009 14-010 C-14-002 C-14-008		
4 (TA-14: Central Area)	5.4	Site wide sampling to determine possible migration of contaminants		5.4.7 5.4.7 5.4.7 5.4.7 5.4.7 5.4.7 5.4.7 5.4.7 5.4.7 5.4.7	14-001(a,b,c) 14-001(d,e) 14-001(g) 14-005 14-006 C-14-005 C-14-006 C-14-007 C-14-003 C-14-004	6.1.2 6.2.3.1 6.2.3.1	14-004(b) 14-004(a) 14-004(c)
5 (TA-14: Septic Tank)	5.5	14-007					
6 (TA-14: East Site & West Magazine)	5.6	14-002(c) 14-002(d) 14-002(e) 14-003	C-14-001 C-14-009				
Unknown						6.2.4.3	14-008

A detailed description of each PRS and the rationale for the associated decision are contained in the subsections of Chapter 5 devoted to that aggregate of PRSs. The order of presentation in each aggregate subsection is HSWA Module VIII SWMUs, non-HSWA Module SWMUs and AOCs, and HSWA and non-HSWA SWMUs and AOCs that are recommended for DA in conjunction with sampling to explore off-site migration.

5.1 TA-12 Firing Site - Aggregate 1: SWMUs 12-001(a) and 12-001(b); and AOCs C-12-001, C-12-002, C-12-003, C-12-004, and C-12-005

5.1.1 Background

TA 12 (L-Site) is a decommissioned firing site totally contained within the present TA-67. TA-67 was established in 1989, when the Laboratory redefined technical area boundaries, and includes TA-12 and a buffer zone. Aggregate 1 at TA-12 contains 7 PRSs subdivided into two parts: west and east (Table 5-2). The rationale for aggregating these PRSs is that they were all part of the same firing site. Also present in this aggregate is SWMUs 12-002 and 12-003 recommended for NFA (see Chapter 6).

L-Site was constructed in 1944 for Explosives Division (X-Division). Early experiments were performed by the Terminal Observations Group (X-1B) (Linschitz 1945, 21-0013). X Division was involved in the development and performance testing of explosives and in the studies of detonation physics. Terminal observations were lens diagnostic methods in which explosives were detonated in close proximity with steel plates or spheres, and the resulting indentations were examined to understand detonation propagation for different types of explosives. The principal structure, constructed in 1944, was a below-ground, steel-lined firing pit (TA-12-4) used for recovery shots. HE calorimetry experiments were performed by Group X-1B during June 1946 (Linschitz 1945, 21-0013).

Group X-1B transferred to M Division in 1946 (Hawkins 1983, 21-0090). During the late 1940s and early 1950s, HE shots were fired at L-Site by several groups including M-6 (Flash Photography) (Watanabe 1993, 21-0083), X-8 (Detonation Wave Research) (Harris 1993, 21-0071), and GMX-2 (Explosives Research and Development) (Harris 1993, 21-0071). By 1951, GMX-2 was the operating group at L-Site (Harris 1993, 21-0071). Unfortunately, former Laboratory employees were unable to recall the specific firing activities at L-Site. By 1962, Group GMX-7 (Detonators, Firing, and Cables) had taken charge of L-Site (Anderson 1962, 21-0012). They supervised a small-scale cleanup of dispersed HE at that time (Anderson 1962, 21-0012).

The following PRSs (see Figure 5-1-1 and 5-1-2) resulted from operations at the L-Site firing area:

Eastern Area

SWMU 12-001(a) (TA-12-4) is a steel-lined firing pit located approximately 800 ft east of the TA-12 entrance. The pit is structured in a hexagonal shape measuring 10.5 ft on each side by 11.5 ft deep. A steel cover 20 ft by 22 ft by 5 ft filled with soil covers the top. The cover has a 5 ft by 5 ft hole in the middle that was used to lower explosives into the firing area. Recovery shots,

Table 5-2

PRSs in the Firing Site Aggregate

PRS	BUILDING NUMBER	DESCRIPTION
Eastern Area:		
12-001(a)	TA-12-4	Firing site (decommissioned)
12-001(b)		Firing site (decommissioned)
C-12-005	TA-12-6	Junction box (decommissioned)
Western Area:		
C-12-001	TA-12-1	Trim building (decommissioned)
C-12-002	TA-12-2	Control chamber (decommissioned)
C-12-003	TA-12-3	Magazine (decommissioned)
C-12-004	TA-12-5	Generator building (decommissioned)

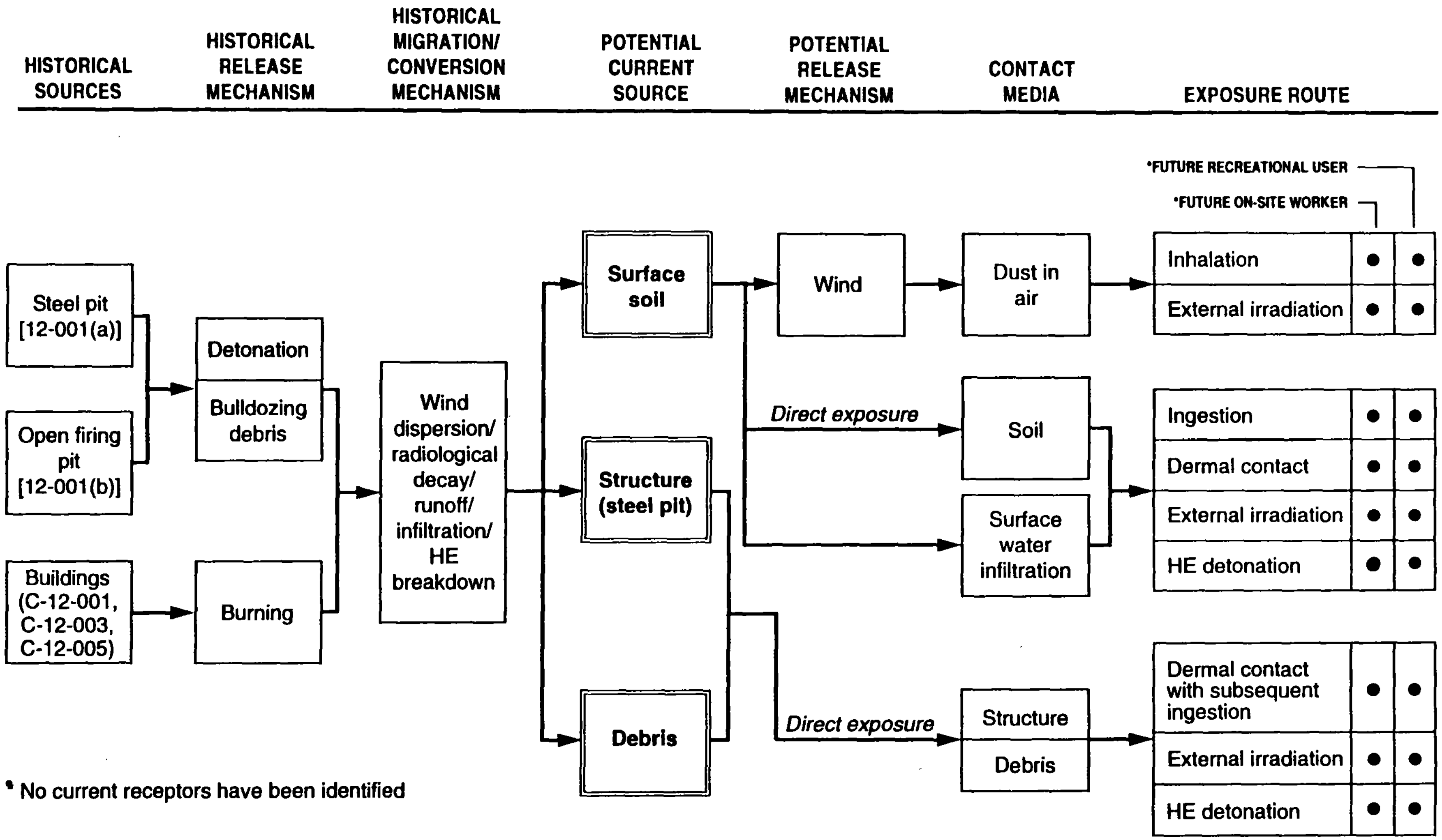


Figure 5-1. Conceptual exposure model for Aggregate 1—TA-12: Inactive Firing Sites.

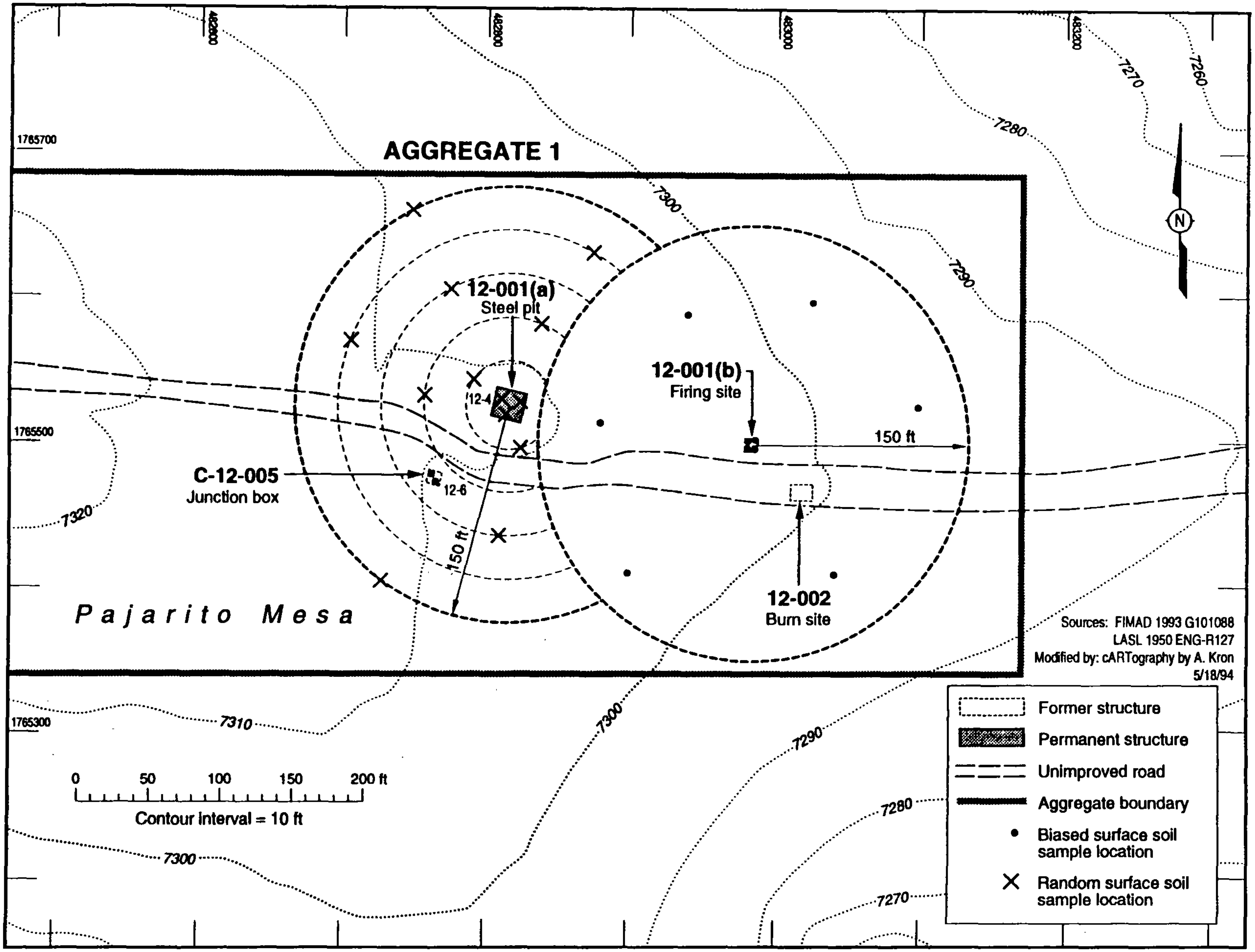


Figure 5-2. Sampling locations in the eastern portion of Aggregate 1—TA-12: Inactive Firing Sites. The steel pit [12-001(a)] and open pit [(12-001(b)] represent the center of the firing sites.

which also involved uranium, were done in the pit. The site was abandoned in 1953, but the firing pit remains intact (LANL 1993, 21-0077).

SWMU 12-001(b) is an open firing pit located approximately 175 ft east of the steel-lined pit [SWMU 12-001(a)] on the north side of Redondo Road. The open pit is an approximately 21 ft long by 17 ft wide by 3 ft deep oval. During 1945, the pit was used by Group X-1B for calorimetric experiments (Martell 1993, 21-0076). A wide range of HE shots involving uranium and lead were done in this pit following World War II.

C-12-005 (TA-12-6) was the junction box for the firing site located 25 ft southwest of the steel-lined firing pit. The purpose of the structure was to act as a relay between the control building (TA-12-2) and the two firing sites. Approximately 750 ft of detonation wire connected the junction box with the control building. This detonation wire and some conduit remain at the site. The structure measured 3 ft wide by 4 ft long by 4 ft high with a soil berm on three sides (LANL 1993, 21-0078). The structure housed diagnostic equipment, signal cables, and electrical power. Explosives were not directly associated with the junction shelter (Martell 1993, 21-0056). The structure was built in 1945, abandoned in 1953, and burned in 1960.

Western Area

This site was abandoned in 1953 and the buildings burned in 1960 (LANL 1993, 21-0078). The typical procedure for disposal of these wooden buildings was to fill each structure with combustible material (e.g., paper, wood, tires), add diesel fuel, and ignite it. Any small amount of unburned material would normally be taken to the S-Site burning ground; remaining non-combustibles would be taken to the material disposal areas. However, remains of the trim building still exist. Funds were not available for cleanup (Martell 1993, 21-0073).

C-12-001 (TA-12-1) was the trim building for the firing site. The building was of wooden frame construction, measuring 16 ft long by 16 ft wide by 9 ft high with soil fill on three sides and on top (LANL 1993, 21-0078). The trim building was built in 1944 and used to prepare HE for detonation. HE was molded at S-Site and then transported to L-Site for final preparation. Pins and detonators were attached to HE within the building. Pins are thin rods around the explosive that are used to time the detonation speed. Sometimes the HE was shaved and trimmed but no major changes were made to the explosive. Scrap trinitrotoluene (TNT) and cyclonite (RDX) from the trim building operation would have amounted to only one pound a month. (Martell 1993, 21-0073).

The building was heated using electricity produced by a nearby generator. The electrical wires running from the generator building (TA-12-5) are still on the ground. The electricity was used to heat ethylene glycol contained in four radiators. Since electrical heating was used, it is believed that the trim building did not have asbestos shingles for fire protection. No evidence of asbestos is visible at the building site (Martell 1993, 21-0073).

C-12-002 (TA-12-2) was the control building for the firing site. This structure was located on the south side of Redondo Road 100 ft east of the TA-12 entrance. The building, constructed in 1945, was of wood frame construction measuring 8 ft long by 8 ft wide by 8 ft high with soil fill on three sides and on top (LANL 1993, 21-0078). It is believed that the presence of radioactivity or chemical PCOCs are unlikely in the structure (Martell 1993, 221-0073). However, a 1959 report indicated that the structure was contaminated with HE (Blackwell 1959, 21-007).

C-12-003 (TA-12-3) was the HE-storage magazine for the firing site. This structure was located on the north side of Redondo Road 50 ft east of the TA-12 entrance. The magazine, built in 1944, measured 6 ft long by 6 ft wide by 7 ft high with soil fill on three sides and top (LANL 1993, 21-0078). Because it is unknown if spillage of explosives occurred, contamination could exist within the building. The bermed soil is all that remains at the site.

C-12-004 (TA-12-5) was the generator building for the firing site. The building was originally located adjacent to TA-12-6, but was then relocated 10 ft north of the control building in March 1952 (LANL 1993, 21-0078). The barrel holder that held the drums of fuel oil remains at the site. It is possible that oil and fuel used to produce heat or generate power may have contaminated the ground under the barrel holder (Martell 1993, 21-0056). The building was abandoned with the rest of the site in 1953.

5.1.3 Conceptual Exposure Model

5.1.3.1 Nature and Extent of Contamination

The firing site PRSs were used in firing experiments and are suspected of being contaminated with HE residues and degradation products, uranium, and metals. Chunks of HE were found scattered around the firing site PRSs. During a screening radiation survey on April 23, 1993, conducted for a preliminary survey, readings of approximately twice background were found in the open firing pit [PRS 12-001(b)] using a Geiger-Müller thin-window probe, indicating the presence of beta-gamma emitting radionuclides (Martell 1993, 21-0066). The steel firing pit [PRS 12-001(a)] was not entered, but no results above background were found using remote survey techniques from outside the structure. However, results of an internal survey of this structure on June 14, 1993, indicated the presence of beta-gamma emitting radionuclides (Martell 1993, 21-0079). The survey results for both PRSs suggest uranium contamination, the beta-gamma emission being mainly from uranium decay products. During the second survey, small pieces of uranium and HE were observed in the open firing pit.

On June 24, 1993, field spot-test kits were used to survey for explosives at the two firing sites. At the steel firing pit, swipes from the outer walls, metal pieces on the ground near the opening of the pit, and soil around the pit were all negative. Swipes taken from the interior of the steel pit, including the white residue on the walls and soil from the bottom (taken earlier during the radiation survey on June 14, 1993), were also negative. All swipes of the surface and near-surface soils, as well as material believed to contain uranium in the open firing pit, were negative. However, small pieces of pink material, identified in earlier field visits, tested positive for trimethylene-trinitramine (RDX) which was consistent with the laboratory analysis of this material. Other pieces of suspected HE tested positive for TNT (Harris 1993, 21-0082).

The other PRSs in this aggregate are the former locations of wooden buildings associated with firing experiments. PRSs C-12-001, C-12-002, and C-12-003 were reported in a 1959 inspection to be contaminated with HE (Blackwell 1959, 21-0007). PRSs C-12-004 and C-12-005 were reported to be free of radioactive and HE contamination (Blackwell 1959, 21-0007). However, C-12-004 was the site of a generator shelter where a stand for fuel barrels still remains. Oil and fuel may have contaminated the ground in this area. Although these buildings were burned in 1960, some of the locations have noncombustible debris remaining in place (concrete blocks, metal radiators, etc.). There is no reason to suspect that radionuclides were ever used in any of the structures.

5.1.3.2 Potential Pathways and Exposure Routes

The conceptual exposure model is presented in Figure 5-2 and a summary of exposure mechanisms and human receptors is presented in Table 5-3.

Surface soils around the pits may have been contaminated due to dispersion of explosives, radionuclides, and metals during detonations. The surrounding area appears to have been scraped or bulldozed to a radius of approximately 150 ft. Information from an expert in similar operations indicates that this was probably done to reduce fire danger from combustion of local vegetation rather than to remove debris from the area (Martell 1993, 21-0073). Some residual contamination, consisting of HE and or HE breakdown products, may remain in surface soils and debris around the burned buildings.

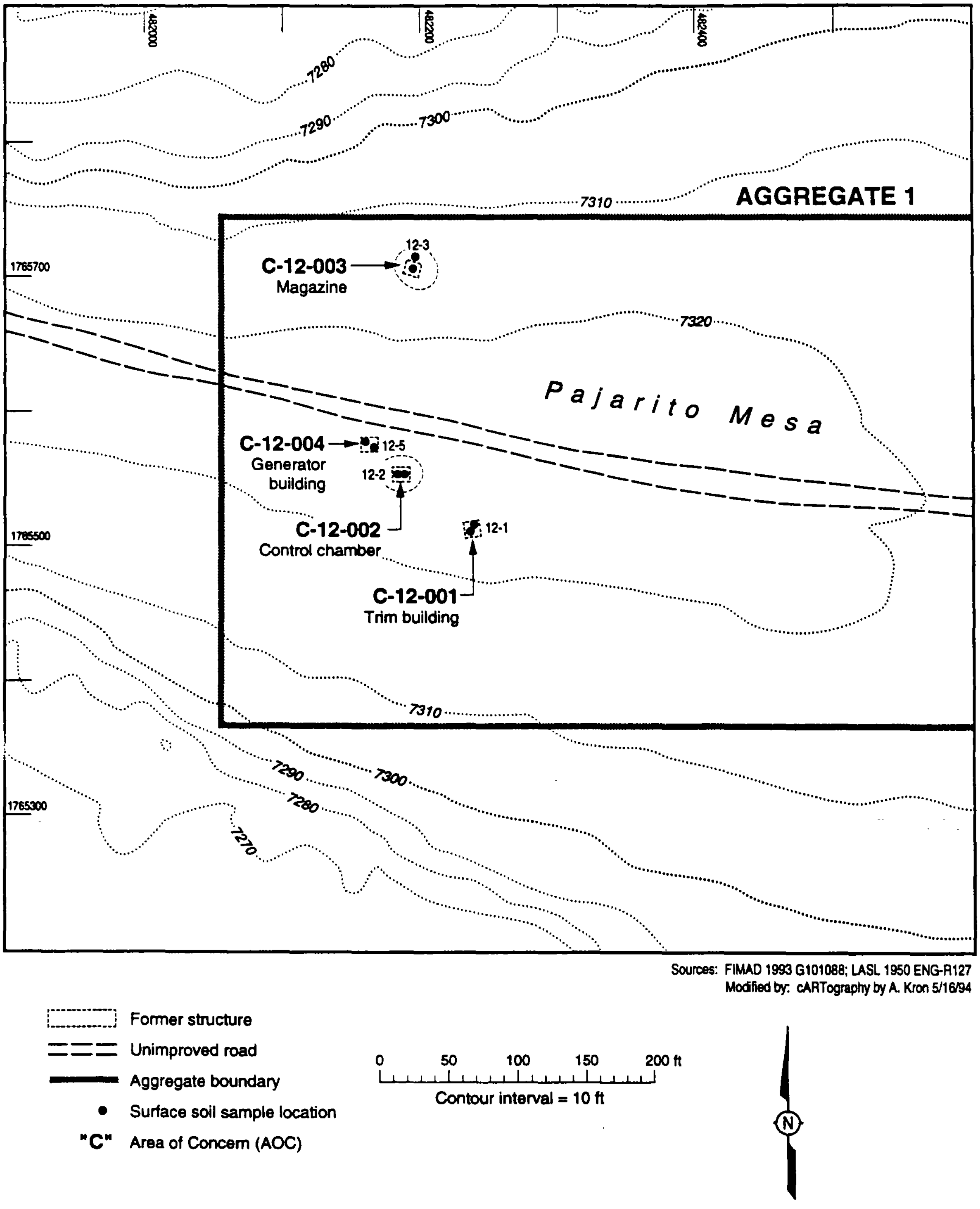


Figure 5-3. Sampling locations in the western portion Aggregate 1—TA-12: Inactive Firing Sites.

Table 5-3

Exposure Mechanisms and Receptors

for L-Site, Aggregate 1

PRS	POTENTIAL AREA OF CONTAMINATION	RELEASE MECHANISM	FUTURE POTENTIAL RECEPTORS
12-001(a), 12-001(b), C-12-001, C-12-002, C-12-003, C-12-004, C-12-005	Surface soil in and around firing pits and at burned buildings	Wind dispersion Surface water infiltration External irradiation	Recreational users On-site workers (e.g.,construction workers)
12-001(a)	Structure (steel pit)	External irradiation	Recreational users On-site workers (e.g.,construction workers)

The mesa in this area is relatively flat and no defined drainage channels are evident; therefore, surface water runoff is not considered to be a major migration pathway. Breakdown of HE (e.g., TNT) into various degradation products has occurred since the site was abandoned.

A more detailed description of the migration pathways, conversion mechanisms, potential receptors, exposure pathways, and exposure assumptions relevant to the entire Operable Unit 1085 are presented in Chapter 4.

5.1.4 Remediation Decisions and Investigation Objectives

5.1.4.1 Problem Statement (DQO Step 1)

The TA-12 firing site aggregate PRSs contain potential HE (e.g., TNT and RDX), metals, total petroleum hydrocarbons (TPH), and radionuclide contamination of surface and near-surface soils due to past firing site operations and burning of associated buildings and structures. The steel-lined firing pit contains soil sediment that may be contaminated due to firing experiments. Since operational activities at the firing sites ceased in the early 1950s, the potential residual explosive materials and other potential contaminants have weathered for approximately 40 years.

The Phase I problem is threefold: 1) evaluate the potential health risk related to exposure to the steel firing pit (PRS 12-006[a]), 2) remove contatminants at PRS 12-001(b) under the VCA option, and 3) determine if PCOCs are present at any of the remaining PRSs contained in the firing site aggregate. PCOCs are defined for most constituents, on a PRS by PRS basis, as contaminants with associated areas of contamination that have concentration levels exceeding a threshold.

Off-site transport of contaminants due to erosion or other natural forces is not anticipated to have significantly occurred, as the topographical relief is slight. Sheet erosion is the most likely source of any slight soil migration.

5.1.4.2 Decision Process (DQO Step 2)

The objective of the Phase I investigation for this aggregate is similarly threefold: 1) characterize the steel firing pit (PRS 12-001(a)) for health risk assessment, 2) conduct a VCA for PRS 12-001(b), and 3) conduct a screening assessment at each remaining PRS to determine if COCs exist in surface soils at concentration levels that are greater than screening action levels (SALs); are outside the normal range of background; or, in combination with other PCOCs, are at screening levels of concern (for details on the generic decision logic for screening assessment, see the 1993 IWP Section 4.1.4 and Appendix J). If any of these three conditions is attained for a set of PCOCs, then those constituents are designated COCs.

If COCs are identified at a PRS, then further action may be taken to refine the conceptual exposure model through further site characterization (e.g., risk assessment), or to proceed directly to consideration of remediation alternatives through a CMS, VCA, or an interim measure. If no COCs are identified for a particular PRS, then NFA will be proposed for that PRS.

5.1.5 Data Quality Objectives for the TA-12 Firing Site Aggregate 1

5.1.5.1 Data Inputs (DQO Step 3)

The primary data needs in support of the screening assessment decisions are identification and concentrations of PCOCs in surface soils. The primary data needs in support of the preliminary baseline risk assessment are the characterization of the unit risk area.

5.1.5.2 Boundaries (DQO Step 4)

The potential boundaries of contamination for PRSs at the TA-12 firing site aggregate are surface soils defined by the individual PRS boundaries and extending to a depth of 6 in. The PRS boundaries for the PRSs are defined as follows:

1. The steel-lined firing pit [SWMU 12-001(a)] boundaries are twofold: the first boundary is defined by the steel-lined pit interior, and the second by an area defined by a 150-ft radius from the center of the steel-lined pit to the surface scraping berms created when the site was clear prior to firing operations in the 1940s. The later boundary excludes the steel-lined pit and the boundary defined by PRS 12-001(b) which is proposed for VCA (Figure 5-2).

2. The boundary for the open firing pit [SWMU 12-001(b)] is also an area defined by a 150-ft radius (Figure 5-2). A central interior area of this circle, corresponding to the firing pit depression, is anticipated to exhibit greater levels of contamination than the perimeter. Consequently, the VCA will be implemented for both the interior area and the outer area.

3. The boundaries of the burned buildings and structures consist of their former sites. These sites are well defined because they have been left intact subsequent to the burn operations. A slight drainage exists on the north side of the former magazine site (C-12-003). This drainage will be investigated in a separate sampling event from the magazine (Figure 5-3).

5.1.5.3 Decision Logic (DQO Step 5)

Risk assessment decision rules are stated for PRS 12-001(a) in terms of the 95% UCL of the arithmetic mean for each COC. If the 95% UCL of the mean is greater than the maximum sampled value, then the maximum value will be used to evaluate health risk. Should the calculated risk exceed target risk values, and the background risk contributes a large share of that risk, a separate risk value related to background concentrations will be calculated.

VCA decision rules for PRS 12-001(b) are that confirmatory sampling will be biased and conducted at sites where large pieces of HE have been removed from the surface soils. Confirmatory sampling for radionuclides will be biased based on radiation field screening values.

Screening assessment decision rules are stated for each remaining PRS in terms of the maximum observed concentration of each PCOC. If, for any PRS, the maximum observed concentration of any PCOC is greater than its SAL and background, then further action may be taken to refine the conceptual exposure model through further site characterization in support of a preliminary risk assessment, or to proceed directly to consideration of a CMS, VCA, or an interim measure. If no PCOCs are above SALs in a PRS, the PRS will be proposed for NFA.

Some adjustments are made to this decision rule to account for PCOCs for which SALs are less than the normal range of background (e.g., beryllium), or if several PCOCs exhibit concentrations that are close to SALs without actually exceeding them. Chapter 4 Subsection 4.1.4 and Appendix J of the IWP (LANL 1993, 1017) provide details of the effect of these adjustments on the decision rule.

5.1.5.4 Design Criteria (DQO Step 6)

5.1.5.4.1 SWMU 12-001(a) and SWMU 12-001(b) Sampling Designs

In the absence of existing data, professional judgment was used to design two screening assessment sampling areas. The sampling conducted for SWMU 12-001(a) will be taken within the 150-ft radius from the center of the steel-lined pit and will include the pit itself. Samples will be taken in a semi-random manner with two sample taken from within the pit, and five randomly at radii of 30 ft, 60 ft, 90 ft, 120 ft, and 150 ft.

VCA will be conducted for SWMU 12-001(b) within the open firing pit and a 150 ft radius. Visible pieces of HE and shrapnel chunks will be removed from the surface soils. All debris will be field-screened for radiation and HE, flashed at the TA-16 burning ground, and removed to an appropriate permitted landfill. Biased confirmatory sampling will then be conducted from the area immediately beneath the removed pieces of HE. Biasing for radiation will be based on radiation field surveys. Five samples will be taken. These samples will be compared with SALs. If these samples are less than SALs, NFA will be recommended. If COCs are identified, then further action may be taken to refine the conceptual exposure model through further site characterization (e.g., risk assessment) or to proceed directly to consideration of remediation alternatives through a CMS, VCA, or an interim measure.

5.1.5.4.2 PRSs 12-001(a) (interior), 12-001(b) (interior), C-12-001, C-12-002, C-12-003, C-12-004, and C-12-005

These seven PRSs will be sampled using a screening assessment approach (Chapter 4). Because of the small size of the PRSs limited by the interior of the pits and building sites two biased samples for each PRS will be taken. Samples will be biased based on HE and/or radiation field surveys.

5.1.6 Phase I Sampling and Analysis Plan

The Phase I sampling plan is threefold: 1) to characterize the steel firing pit (PRS 12-006[a]) for a baseline health risk assessment, 2) to conduct confirmatory sampling following VCA for PRS 12-001(b), and 3) determine the presence of absence of PCOCs above SALs and background concentrations. If the guideline criteria are not met then a Phase II approach will be initiated as discussed in Section 5.1.5.4 .

Field Screening. All samples will be field screened for gross alpha, beta, and gamma to detect the presence of the radionuclides. In addition, samples from PRS that had not been field surveyed for HE will be swiped and tested with the HE spot test. The PAH spot test will be used at the generator pad (PRS C-12-004) to detect the presence of petroleum fuel residuals. The grid samples will be screened by x-ray fluorescence for metals and GC/PID for semivolatile organics. The following biasing scheme will be used to select samples for laboratory analysis within the grid samples:

- Samples with positive HE readings;
- Samples with positive (2 times background) and readings;
- Samples with any metal above SALs; and,
- Samples containing detectable semivolatile organics such as PAHs.

Appropriate health and safety precautions will be followed according to the Laboratory's ER Program SOPs (LANL 1993, 0875).

5.1.6.1 Engineering Surveys and VCA of Debris and HE

Engineering surveys will locate, stake, and document PRS boundaries, the areas for radiation screening, HE screening, surface and near-surface sampling, and all surface engineering and geomorphic features. All sample locations will be registered on a base map, scale 1:1200. If during the course of sampling, any sample points must be relocated, the new position will be resurveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional surveyor under the supervision of the field team leader.

5.1.6.2 Sampling

5.1.6.2.1 Sampling Rationale

Many of the PRSs considered in this firing site aggregate resulted from related contaminant dispersal processes; thus, aggregate-wide surface sampling provides coverage for several of these PRSs.

5.1.6.2.2 Sampling Techniques

Soil samples will be collected from the surface to a depth of 6 in. by an appropriate technique (spade and scoop, hand-auger, and others as deemed appropriate by the field team leader). If, from the results of this sampling, it is apparent that deeper sampling is necessary, this will be done in Phase II characterization.

See Figures 5-2 and 5-3 for planned sample locations.

5.1.6.3 Sampling Summaries

SWMU 12-001(a) and SWMU 12-001(b)

Area Sampling

A spaced sampling radius will be surveyed over SWMUs 12-001(a) and (b) as approximately shown in Figure 5-2 yielding 5 sampling points each. Surface samples (0 to 6 in.) will be semi-random for PRS 12-001(a) and biased for PRS 12-001(b).

Interior Sampling

The floor of the steel pit [12-001(a)] is covered with a small amount of soil. This soil will be randomly sampled at two location. The pit is hexagonal in shape with 10 ft long concrete walls. Two surface sample will be taken of the open firing site [12-001(b)], the location to be selected by the team leader.

C-12-001, Trim Building. Sampling at this AOC will consist of the collection of two surface samples to a depth of 6 in. The physical location of the two surface samples will be

- In the north east interior of the trim building, and,
- In the center of the trim building floor (Figure 5-3).

C-12-002, Control Chamber. Sampling at this AOC will consist of the collection of two surface soil samples. Each sample location will yield one analytical sample, 0 to 6 in. The physical location of the two surface soil samples will be

- In the center of the remains, and
- On the rim of the berm (Figure 5-3).

C-12-003, Magazine. Two surface samples to a depth of 6 in. will be gathered at the magazine. Each sample location will yield one analytical sample, 0 to 6 in. The physical location of the two samples will be

- In the center of the magazine floor, and
- Five feet downslope from the center of the magazine floor (Figure 5-3).

C-12-004, Generator Pad. Sampling at this AOC will consist of the collection of two surface samples to a depth of 6 in. Each sample location will yield one analytical sample, 0 to 6 in., and will be located at random on the surface of the generator pad (Figure 5-3).

C-12-005, Junction Box. Sampling at this AOC will consist of the collection of two samples to a depth of 6 in. Each sample location will yield one analytical sample, 0 to 6 in., and will be located at random on the surface of the junction box (Figure 5-3).

5.1.6.4 Laboratory Analysis

Fixed Base Laboratory. Fixed base laboratory analyses for radionuclides, HE, and metals will be based upon the following methods: Laboratory or DOE methods for alpha, beta, and gamma spectrometry, SW-846 method 6010 for metals, SW-846 method 8270 for semivolatiles, and SW-846 method 8330 for HE and HE degradation products. The principle radionuclide of concern is uranium-235; the principle semivolatile organic compounds (SVOCs) of concern are HE and HE byproducts and detonation products as well as petroleum fuel residuals at the generator pad (C-12-004). The metals of concern are barium, beryllium, chromium, cadmium, lead, and uranium.

5.1.6.5 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the latest revision of the IWP (LANL 1993, 1017). Any quality assurance/ quality control (QA/QC) duplicate samples planned to be collected during the course of the field investigation are outlined in Table 5-4.

Table 5-4 Summary of OU 1085 Site Surveys, Sampling and Analysis Aggregate 5

PRS	PRS Type	Phase 1 Approach	Sample Media	Field Surveys: Land Surveys	Field Surveys: Geophysics	Field Surveys: High Explosives	Field Surveys: Polynuclear Aromatic Hydrocarbons	Field Screening: Radiation	Field Screening: Gross Gamma/Beta	Field Screening: High Explosives	Field Screening: Organic Vapor	Samples	Samples: duplicates	Analysis: Gamma Spectroscopy	Analysis: High Explosives	Analysis: Isotopic Uranium	Analysis: Metals	Analysis: Semi-Volatiles (SW8270)
12-001(a)	Steel pit, Firing Site	Risk Assessment Characterization	Soil in Steel pit						X	X		2		X	X	X	X	
12-001(a)	Steel pit, Firing Site	Risk Assessment Characterization	Soil	X					X	X		5	1	X	X	X	X	
12-001(b)	Open pit, Firing Site	Voluntary Corrective Action	Soil in pit					X	X	X		2		X	X	X	X	
12-001(b)	Open pit, Firing Site	Voluntary Corrective Action	Soil	X				X	X	X		5	1	X	X	X	X	
C12-001	Trim Building	Screening Assessment	Soil in building			X			X			2			X			
C12-002	Control Chamber	Screening Assessment	Soil in building			X		X	X			2			X	X	X	
C12-003	Magazine	Screening Assessment	Soil in building			X			X			2			X		X	
C12-004	Generator Building	Screening Assessment	Soil in building				X		X		X	2						X
C12-005	Junction Box	Screening Assessment	Soil in building			X		X	X			2			X	X		

5.2 Aggregate 2. TA-12 Radioactive Lanthanum Site, SWMUS 12-004(a) and 12-004(b)

5.2.1 Background

The radioactive lanthanum site was constructed in March 1950 to conduct radiation experiments on animals (Walsh 1950, 21-0009). The aggregate consists of two PRSs, 12-004(a) and 12-004(b). The aggregate is located at the east end of Pajarito Mesa (Figure 1-5). Although this aggregate is now located in OU 1086 (TA-15), the SWMUs were assigned numbers associated with TA-12 because this site was originally in TA-12, as shown by the structure number of the bunker. Because this aggregate is isolated in location and is unlike any other in TA-15 there is no reason to include the area in OU 1086. SWMU 12-004(a) is the area surrounding the radiation experiment site. It includes a bermed radiation shelter (TA-12-8) and three telephone poles. The shelter and three poles, which are still standing, were constructed in a line parallel to a drainage channel that flows southwest from Redondo Road to the edge of Threemile Canyon. The northernmost telephone pole lies 30 ft south of Redondo Road, and the second pole lies 58 ft south of the first. The radiation shelter and third pole are located 40 ft south of the second pole.

SWMU 12-004(b) is an aluminum pipe located on the edge of Redondo Road. It sits 78 ft north of the radiation shelter. The pipe protrudes 8 in. above ground and resembles a manhole outlet without a cover. The opening measures 25.5 in. outer diameter, and 20 in. inner diameter, with a visible depth of approximately 3 ft. The inside of the pipe is filled with soil, and it is not known how deep the pipe extends into the ground. These PRSs have been aggregated because they are located in the same geographical area.

5.2.2 Description and History

In May of 1950, an experiment involving a 1000 Ci source of radioactive lanthanum was conducted at the far east side of L-site. The purpose of the experiment was to test the effects of various radiation doses on animals, in particular to determine the effects of

- Height above ground;
- Depth below ground;
- Variations in wall thicknesses of various animal containers; and/or
- Variations in doses with change in source receiver angles.

Operators deployed the source remotely from a soil-bermed shelter by raising it with a wire strung over three telephone poles. The source was stored in a lead container (or "pig") at the base of the first pole. The source could be deployed at various heights by raising it inside of a Lucite guide tube attached to this pole. Test animal containers were located at various distances from the source. Different containers of various thicknesses and shapes were used to observe the effects of foreign elements. This experiment was conducted over a 3-wk period under the direction of the Biomedical Group (H-4) (Walsh 1950, 21-0009).

SWMU 12-004(b), the aluminum pipe, has no documented history. The pipe was measured (inside, outside, and at the bottom) for beta/gamma radioactivity, but none of the areas measured above background (Martell 1993, 21-0066). It is possible that small-scale firing of HEs occurred at this area, because HEs are reported at the site (Blackwell 1959, 21-0002).

5.2.3 Conceptual Exposure Model

5.2.3.1 Nature and Extent of Contamination

PRS 12-004(a) was the site of animal irradiation experiments in 1950. A 1000-Ci sealed source of lanthanum-140 in transient equilibrium with barium-140 was used in the experiments. The chemical separation techniques used to isolate the barium-140 from other fission products allowed a small amount of strontium-90 (approximately 0.03% by initial activity) in the sources. In the more than 42 years since the experiment, any barium-140 (half-life 12.8 days) or lanthanum-140 (half-life 1.7 days) has completely decayed away, leaving approximately 35% of any strontium-90 remaining (half-life 29 years).

Although the sources used in 1950 were "sealed," a site contact indicated that the source exteriors were frequently contaminated because of pinhole leaks (Potter 1993, 21-0074). It appears that during the experiments the lead pig, Lucite pipe, and the area around the base of the pole were contaminated. A 1959 survey reported the shelter and pole to be contaminated with HEs and strontium-90 (Blackwell 1959, 21-0002). In 1966, the area was surveyed, and all remaining structures and equipment were found to be contaminated (Blackwell 1966, 21-0005). At some point, the area was decontaminated. The lead pig and the Lucite pipe were removed, and the pole was cut off near ground level and removed (Blackwell 1966, 21-0005). There is also visual evidence that some soil was removed near the base of the pole. There is no record of a closeout survey done at the completion of these decontamination efforts.

During a screening radiation survey conducted on April 23, 1993, a Geiger-Müller thin window probe gave readings of approximately 10 times background on a cardboard box inside the shelter indicating the presence of beta-gamma emitting radionuclides (Martell 1993, 21-0066). No other readings above background were observed.

During the radiation survey conducted on April 23, 1993, no readings above background were found at PRS 12-004(b) even though its proximity to the source experiments suggest that the pipe could have been contaminated.

5.2.3.2 Potential Pathways and Exposure Routes

The conceptual exposure model is presented in Figure 5-4. A summary of exposure mechanisms and human receptors is presented in Table 5-5.

A drainage channel from the vicinity of the third pole leading south to the canyon rim provides a surface water run-off pathway. Infiltration of surface water could also have transported contaminants into the sediments and soil in the drainage.

A more detailed description of the migration pathways, conversion mechanisms, potential receptors, exposure pathways, and exposure assumptions relevant to the entire OU is presented in Chapter 4.

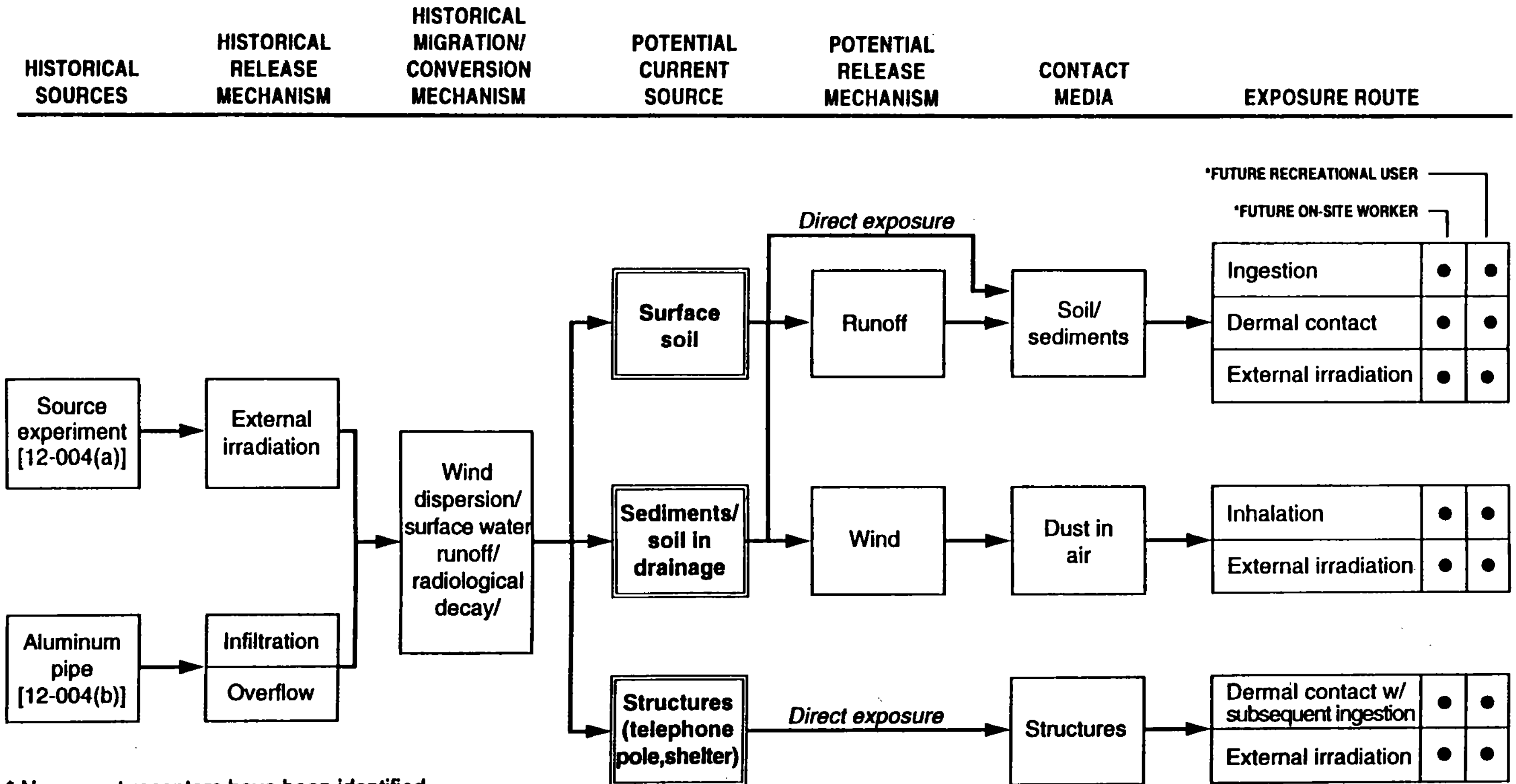
5.2.4 Remediation Decisions and Investigation Objectives

The previous subsections introduced the lanthanum site aggregate PRSs. This subsection provides the details of the sampling plans, including the potential contaminants of concern (PCOCs) and the number and location of soil samples to be collected.

5.2.4.1 Problem Statement Data Quality Objective [(DQO) Step 1]

The TA-12 lanthanum site aggregate PRSs could contain HEs (e.g., TNT and RDX), metals, strontium-90, and other radionuclide contamination of surface and near-surface soils derived from a series of experiments performed at the lanthanum site in 1950. The area had previously tested positive for HE contamination (Blackwell 1959, 21-0007). Operational activities at the site ceased subsequent to the conclusion of the lanthanum experiment; therefore, the potential residual explosive materials and other potential contaminants have weathered for approximately 40 years. The source for the aluminum pipe remains unknown. Because of the lack of information about the pipe and because of the proximity of the pipe to the lanthanum site, the area around the pipe may be contaminated with HEs and radionuclides.

The Phase I problem is to determine if COCs are present at either of the PRSs contained in the lanthanum site aggregate. COCs are defined for most constituents on a PRS-by-PRS basis as are contaminants with associated areas of contamination that have concentration levels exceeding a threshold.



* No current receptors have been identified

Figure 5-4. Conceptual exposure model for Aggregate 2—Radioactive Lanthanum Site.

TABLE 5-5
Exposure Mechanisms and Receptors for Aggregate 2

(Radioactive Lanthanum Site)

PRS	POTENTIAL AREA OF CONTAMINATION	RELEASE MECHANISM	FUTURE POTENTIAL RECEPTORS
12-004(a), 12-004(b)	Surface soil Sediments and soil in drainage	Erosion or excavation, resulting in wind dispersion Surface water run-off and infiltration External irradiation	Recreational users On-site workers (e.g., construction)
12-004(a), 12-004(b)	Structures (telephone pole, radiation shelter, and pipe)	External irradiation	Recreational users On-site workers (e.g., construction)

5.2.4.2 Decision Process (DQO Step 2)

The objective of the Phase I investigation for this aggregate will be to complete a screening assessment at each PRS to determine if PCOCs exist in surface and near-surface soils at concentration levels that are greater than SALs, are outside the normal range of background, or, in combination with other PCOCs, are at screening levels of concern (for details on the generic decision logic for screening assessment, see the 1993 IWP Subsection 4.1.4 and Appendix J). If any of these three conditions is attained for a set of PCOCs, then those constituents are COC.

If COCs are identified at a PRS, then further action may be taken to refine the conceptual exposure model through further site characterization (e.g., risk assessment) or to proceed directly to consideration of remediation alternatives through a CMS, VCA, or an interim measure. If no COCs are identified for a particular PRS, then NFA will be proposed for that PRS.

5.2.5 Data Needs and Data Quality Objectives

5.2.5.1 Data Inputs (DQO Step 3)

The primary data needs in support of the screening assessment decisions are identification and concentrations of PCOCs in surface and near-surface soils. The concentrations of PCOCs are compared to their SALS. If the PCOCs are less than the SALs and background concentration, the PRS will be recommended for NFA.

5.2.5.2 Boundaries (DQO Step 4)

The potential boundaries of contamination for PRSs at the TA-12 lanthanum site aggregate are surface and near-surface soils, as defined by the individual PRS boundaries and extending to a depth of 6 in. The PRS boundaries are defined as follows:

1. The lanthanum experiment site [SWMU 12-004(a)] boundary is defined to contain all elements of the experiment site, including the shelter and the sites of the three telephone poles. It also extends down the small drainage through the site.

2. The boundary for the aluminum pipe [SWMU 12-004(b)] is twofold: the aluminum pipe itself and the soil inside of the pipe.

However, an initial visual surface examination of residual HEs of the surrounding area will be conducted first. If any HE is observed, then this work plan will be adapted to include a VCA similar to that described for PRS 12-001(b) in Section 5.1. However, after more than 40 years, the expectations of finding HEs are low.

5.2.5.3 Decision Logic (DQO Step 5)

Screening assessment decision rules are stated for each PRS in terms of the maximum observed concentration of each PCOC. If for any PRS the maximum PCOC concentration is greater than its SAL and background, then further action may be taken to refine the conceptual exposure model through further site characterization in support of a preliminary risk assessment, or to proceed directly to consideration of a CMS, VCA, or an interim measure. If non PCOCs are above SALs in a PRS, the PRS will be proposed for NFA.

Some adjustments are made to this decision rule to account for PCOCs for which SALs are less than the normal range of background (e.g., beryllium) or if several PCOCs exhibit concentrations that are close to SALs without actually exceeding them. Chapter 4 (Subsection 4.1.4) and Appendix J of the IWP (LANL 1993, 1017) provide details of the effect of these adjustments on the decision rule.

5.2.5.4 Design Criteria (DQO Step 6)

SWMU 12-004(a) will be sampled using a screening assessment approach (Chapter 4). Potential contamination is likely to be heterogeneously distributed and of moderate level. The nomogram approach as laid out in the IWP (LANL 1993, 1017) suggests that six laboratory samples will provide an 80% chance of discovering contamination if 25% of the SWMU is contaminated. The six samples will be selected from within 14 samples surveyed for HEs and radionuclides.

PRS 12-004(b) is so small that two samples will be taken from the center of the aluminum pipe, a surface soil sample (0-6 in) and a sample at the soil-tuff interface.

5.2.6 Phase I Sampling and Analysis Plan

Phase I sampling will focus on determining the presence or absence of PCOCs above SALs. If necessary, a Phase II sampling plan will further define the nature, extent, and rate of migration of any release identified in Phase I. Refer to Appendixes D and E for additional OU 1085 field sampling information including SOPs used in this sampling plan. These appendices are Appendix E, Field Investigation Approach and Methods; and Appendix D, OU 1085 Maps.

Field Screening. All samples will be field-screened for gross alpha, beta, and gamma to detect the presence of radionuclides. The HE spot test will be used to detect the presence of HEs. The following biasing scheme will be used to select samples for laboratory analysis:

- Samples with high (two times) background radionuclide readings, and
- Samples with positive HE spot tests.

Appropriate health and safety precautions will be undertaken according to the Laboratory's Environmental Restoration (ER) Program standard operating procedures (SOPs) (LANL 1993, 0875).

5.2.6.1 Engineering Surveys

Engineering surveys will locate, stake, and document PRS boundaries, the areas for radiation screening, HE screening, surface and subsurface sampling, and all surface engineering and geomorphic features. All sample locations will be registered on a base map, scale 1:1 200. If during the course of sampling any sample points must be relocated, the new position will be resurveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional surveyor under the supervision of the field team leader.

5.2.6.2 Sampling

5.2.6.2.1 Sampling Rationale

The two PRSs in this radioactive lanthanum aggregate resulted from localized animal irradiation experiments. Screening of the area after these experiments has yielded above-background radionuclide concentrations, so sampling is designed to locate any radionuclide-contaminated soil.

Sampling of the aluminum pipe will also be designed to detect the presence of HEs.

5.2.6.2.2 Sampling Techniques

Sampling at this aggregate will be exclusively of surface soil samples. These samples will be gathered with either the spade and scoop or ring sampler technique to a depth of 6 in. The specific technique will be determined by the field team leader. A depth of 6 in. is deemed necessary because the more than 40 years of weathering and the heterogeneity of soil mean contaminants will not be uniformly distributed. A smaller sample may not be representative of the area.

See Figure 5-5 for planned screening locations and Table 5-6 for a listing of planned sampling.

5.2.6.2.3 Sampling Summaries

SWMU 12-004(a), Animal Irradiation Site. The structures at this PRS consist of the radiation shelter and the stump of a telephone pole that is in alignment with two other intact telephone poles that were part of the system used to hoist the radioactive lanthanum source in and out of its shielding. Screening at this SWMU (as discussed in 5.2.5.4) will consist of

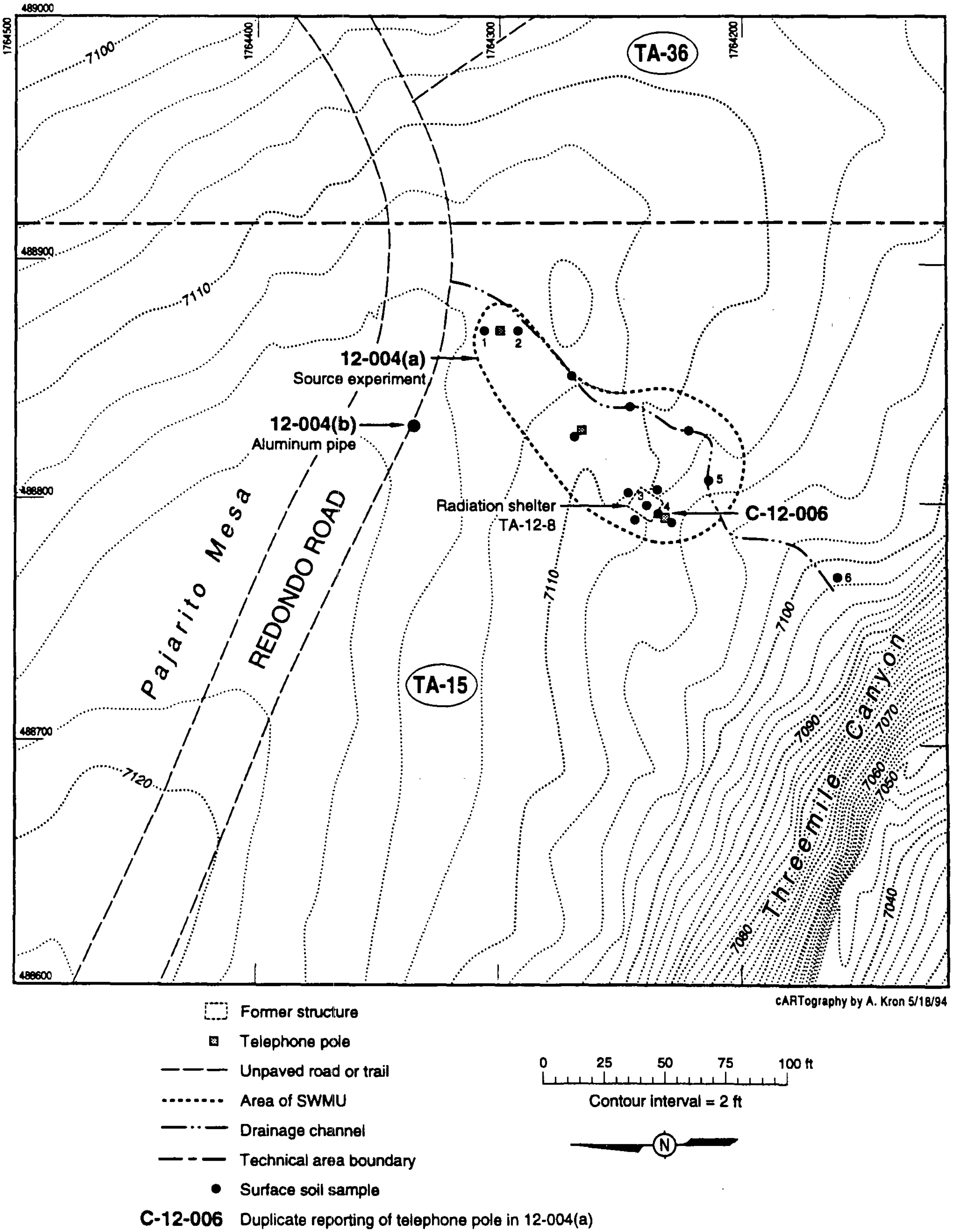


Figure 5-5. Sampling locations in Aggregate 2—Radioactive Lanthanum Site.

- Two surface soil samples at the telephone pole stump, one at the base of the stump, and one 5 ft to the south in the drainage;
- Two surface soil samples, one each at the base of the two standing telephone poles;
- Five surface soil samples at the radiation shelter structure, one on each exterior side of the shelter and one in the interior; and
- Four additional points in the drainage (Figure 5-5).

One additional sample in the drainage channel will constitute mostly sediment, the exact location of which will be determined by the field team leader. Samples will be biased based on HE and radiation field survey results.

All samples will be taken from 0 to 6 in. and each sample yields one analytical sample. The biasing scheme described above will be used to select six analytical samples from within this group of 14 screening samples.

If no screening indicators are found or if less than six samples yield positive indicators, the additional samples will be selected in the order shown on Figure 5-5. If more than six samples yield positive screening results, the samples farthest downgradient will be selected in order to evaluate off-site migration.

The spade and scoop or ring sampler methods will be used to collect samples at each location. The PCOCs at SWMU 12-004(a) are HEs, strontium-90, and metals.

SWMU 12-004(b), Aluminum Pipe. Sampling at this SWMU will consist of the collection of one soil sample to a depth of 6 in. and at the soil-tuff interface. This will be field screened and sent for laboratory analysis.

5.2.6.3 Fixed-Base Laboratory Analysis

Fixed base laboratory analyses for radionuclides, HEs, and metals will be based upon the following methods: LANL or DOE methods for alpha, beta, and gamma spectrometry, SW-846 method 6010 for metals, SW-846 method 8330 for HEs and HE degradation products. The principle radionuclide of concern is strontium-90; the principle SVOCs of concern are HEs and HE byproducts and detonation products. The metals of concern are barium, beryllium, chromium, cadmium, lead, and uranium.

5.2.6.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the latest revision of the IWP (LANL 1993, 1017). Quality assessment/quality control (QA/QC) duplicate samples planned to be collected during the course of the field investigation are outlined in Table 5-6.

Table 5-6
Sample Analysis for Aggregate 2

						Field Survey					Field Screening			Laboratory Analyses				
PRS	Prs Type	Phase 1 Approach	Sample Media	Samples	Duplicates	Land Survey	Geophysics	High Explosives	Polynuclear Aromatic Hydrocarbons	Radiation	Gross Beta/Gamma	High Explosives	Organic Vapor	Gamma Spectroscopy	High Explosives	Isotopic Uranium	Metals	Semivolatiles
12-004(a)	Source Experiment	Screening Assessment	Soil	14	1	X		X		X	x	x		x	x		x	
12-004(b)	Aluminum Pipe	Screening Assessment	Soil in pipe	2		X				X	X	X	X	X	X		X	X

5.3 AGGREGATE 3. Western area at TA-14: SWMUs 14-001(f), 14-002(a,b,f), 14-009, and 14-010; and AOCs C-14-002 and C-14-008

5.3.1 Background

The firing site aggregate at the western end of TA-14 contained structures that are typical of a firing site. These include a closed firing chamber (TA-14-2) and an open firing pedestal (TA-14-17). Aggregate 3 also currently includes a bullet test facility (TA-14-34) and an HE test facility (TA-14-39). The aggregate contains two AOCs, and six SWMUs (Table 5-7).

SWMU 14-001(f) is an active site and will not be remediated until the site is decommissioned. Surface soil will be sampled in the surrounding drainages to determine if potential contaminants have migrated from the source area. If necessary, an interim action to prevent off-site migration from past contamination will be instigated to protect human health. Currently, waste materials are collected and stored in drums at an approved satellite accumulation area for removal.

5.3.2 Description and History

TA-14 is located 3 miles east of TA-9 and 0.5 miles west of TA-15 on Redondo Road (Figure 1-6). It is situated on the southern edge of Pajarito Mesa. Western TA-14 slopes to the south, then drops approximately 30 ft into Cañon de Valle.

Vegetation within TA-14 is primarily pine forest with dense stands of relatively young ponderosa pine to more open stands of mature ponderosa pine and mixed conifer forest with open, grassy meadows.

TA-14, known as Q-site, was constructed in 1944 by Explosives Division (X Division) for close observation of small explosive charges. During World War II, the west end of Q-site included both a closed chamber (TA-14-2) and an open firing pedestal (TA-14-17). Group X-1B used the firing pedestal for recovery shots in October 1944 (see Figure 1-6). The closed chamber failed structurally after several charges had been fired within it (Betts 1947, 21-0038). TA-14-2 was later used as a bullet impact firing chamber, in which low-order detonations were common (Courtwright 1973, 21-0067). This firing frequently involved radioactive materials (Courtwright 1973, 21-0023). TA-14-2 was decommissioned and removed in 1973.

The firing pedestal was decommissioned and replaced by a bullet test facility (TA-14-34) in 1957. TA-14-34 continues to be used for a variety of experiments including HE and gun/bullet tests.

TA-14-39, an HE test facility, and TA-14-40, an instrumentation building, were constructed on the former site of TA-14-2 in the 1970s.

TABLE 5-7

AGGREGATE 3

PRSs in the Western Area at TA-14

PRS	STRUCTURE NUMBER	DESCRIPTION
14-001(f)	TA-14-34	Remediation deferred until D&D
14-002(a)	TA-14-2	Closed firing chamber (decommissioned)
14-002(b)	TA-14-17	Open firing pedestal (decommissioned)
14-002(f)	TA-14-12	Junction box (decommissioned)
14-009		Surface disposal area
14-010	TA-14-2	Sump (decommissioned)
C-14-002	TA-14-3	Control building (decommissioned)
C-14-008	TA-14-11	Magazine (decommissioned)

TA-14 remains an active site with tests scheduled at the bullet test facility (western TA-14). The following PRSs resulted from firing activities at the western end of TA-14.

SWMU 14-001(f) (TA-14-34) is a gun firing site but is referred to as a bullet test facility. TA-14-34 is a reinforced concrete building 13.3 by 13.6 by 8 ft tall (LANL 1993, 21-0077). The bullet test facility is located in the center of the western portion of Q-site on level ground that drains to the southwest. M-8 group operates the bullet firing facility. Many types of bullets, including copper-jacketed lead, plastic, steel, and depleted uranium, are used. The firing is done in a 10-ft-diameter steel tube so that the test material is usually contained in the tube or is vaporized. If these residuals are believed to be contaminated with uranium, they are placed in 55-gal. drums for disposal. Any HE-contaminated scrap or shrapnel is also placed in 55-gal. drums for pickup and treatment as HE-contaminated waste. Scrap that is neither HE- nor uranium-contaminated is sent to the sanitary landfill. Sandbags are used for shielding disintegrate from blast pressure. When removed, they are used for erosion control at the site.

SWMU 14-002(a) (TA-14-2) is a decommissioned, closed HEs firing chamber completed October 1, 1944, of heavily reinforced concrete construction 16 by 21.6 by 13 ft tall with steel plate lining (LANL 1993, 21-0077). TA-14-2 was not used during World War II; however, Courtwright (1973, 21-0028) suggests that it was later used extensively for HE tests, many of which involved uranium, low-order detonations, or both. In the early 1970s, the decision was made to remove closed chamber TA-14-2 because a new HE test facility was to be built in the same area. A survey of the bunker found that the building was contaminated with alpha radiation (from uranium) to the following levels: floors, 1200 d/m, 1000 - 4000 d/m; ceiling, 2000 to 12 000 d/m over 60 cm^2 alpha. The plating on the steel wall that was contaminated with uranium was removed and the contaminated sand at the side of the building was taken to the radioactive disposal pit at TA-54. Apparently, the building was burned on-site in 1973. The remaining noncombustible building materials with minimal HEs and radionuclide contamination were placed in Cañon de Valle north of TA-16-387 in material disposal area (MDA) P. Pieces contaminated with HEs went to Area J, whereas radioactive pieces went to Area G (Courtwright 1973, 21-0067). The HE sump, TA-14-010, associated with the building was removed at this time. Asphalt in the surrounding area contaminated with uranium was apparently also removed and taken to Area G (Gibbons 1973, 21-0067). Zia plant records show that a water line to the outside building wall was installed in June 1960 (Russo 1973, 21-0067). A decision to abandon the water line was on hold until the Los Alamos Scientific Laboratory (LASL) had completed the design and planning criteria for the new building. It is possible that the new water line was utilized when the new chamber was constructed.

SWMU 14-002(b) (TA-14-17) is a former HE-firing pedestal that was completed January 5, 1945, of reinforced concrete construction 4-ft long by 4-ft wide by 2-ft thick with a steel plate top and an 8-ft-high earthen barricade. TA-14-17 was located in the west-central portion of the western TA-14 firing site. The former site of the firing pedestal is level, with drainage to the southwest. The horseshoe geometry of the steel open chamber measured 10 ft in diameter by 30-ft-long with a 40-in.-thick wall. The open horseshoe-shaped chamber faced south away from surrounding structures and magazines. The targets were planar cross sections of weapons that contained HEs. Bullets were fired into the HEs, starting with small caliber bullets and progressing up to 150 caliber. These tests detonated, burned, or shattered the target. Natural or depleted uranium was sometimes in the weapons' cross section. Also small shape-charge tests were performed. Light armour weapons (LAWs) were demilitarized and the warheads fired into reactive armor targets containing explosives. Linear shape-charge tests were done on a routine basis. Line cutter-shape charges were fired into weapon cross section targets containing lithium hydride. These firing activities probably produced low-order detonations.

Sandbags were used to protect the x-ray film and equipment from the blast and shrapnel. When the bags were torn, the sand and shot debris were shoveled into a wheelbarrow and dumped into the edge of the canyon. Uranium bullets were fired, which would often start fires in the surrounding area.

The area is contaminated with uranium, lead, and copper, as well as explosives. The copper came from the small guiding metal jackets on the bullets. Some antimony was alloyed into the bullet lead to increase hardness. There is barium nitrate in the area because of the use of inerts as well as Baratol. After a series of shots, the area was swept and HEs, shrapnel, and debris picked up. The surface soil was not removed (Harris 1993, 21-0057). The open chamber/firing pedestal was removed in March, 1952 (LANL 1993, 21-0077).

SWMU 14-002(f) (TA-14-12) is a former junction box shelter built approximately January 1945, of wooden frame construction 6 ft long by 6 ft wide by 6 ft tall, with earthen fill on three sides (Figure 1-6). It was removed in March 1952 (LANL 1993, 21-0077). The site may be contaminated because of its close proximity to other areas.

SWMU 14-009 (TA-14) is a surface disposal area on the southwest slope of the western firing area. This waste pile consists of ruptured sandbags. When explosives were tested, sandbags were placed around a firing site to contain the detonation. When the pressure of the blasts ruptured the sandbags, the sand was used for erosion control around the firing site. The sand has been placed over a slope with an area of approximately 45 ft by 50 ft to an approximate depth of 1 ft. Sandbags used at firing sites could be contaminated with uranium, lead, beryllium, and HE compounds. Uranium has been noted in soils in some areas at TA-14. Whether the source of the uranium was the surface disposal of sandbags, storage, and/or firing activities is not known. The waste pile was surveyed for radioactivity as part of the DOE Environmental Survey in 1987. The survey indicated detectable radioactivity above background at the site (LANL 1990, 0145).

SWMU 14-010 (TA-14-2) is a decommissioned explosive waste sump next to TA-14-2. A drain extended from the sump across the road (Courtwright 21-0023). A concrete sump was located south of and adjacent to TA-14-2 and may have contained HEs and toxic chemicals (Ortiz 1973, 21-0067). The contents of the sump adjacent to the structure were removed and disposed of by the WX-2 Group (Russo 1973, 21-0067). The sump and drain line around the base of the floor slab for TA-14-2 were dug out by hand and removed (Owen 1973, 21-0067).

C-14-002 (TA-14-3) is a former control building, built in October 1944, of wooden construction 8 ft wide by 14 ft long by 8 ft high with an addition of 6 ft wide by 6 ft long by 8 ft high. It was removed in March 1952 (LANL 1993, 21-0077). Because of the location, the area may have residual contamination.

C-14-008 (TA-14-11), a former magazine, is located about 75 ft northeast of the current magazine, TA-14-30, in the west complex (Figure 1-6). It was built of wooden construction 5 ft long by 5 ft wide by 5 ft high, with an earthen berm on three sides and the top. This structure was constructed in January 1945 and was removed in March 1952 (LANL 1993, 21-0077). The location of this magazine has been determined from LANL photographs (11547, 280). The former site of the building has been cleared and scraped; dirt has been heaped in a long, low pile along the north edge of the pavement. This dirt may have been deposited from clearing the paved area and from the former berm surrounding the magazine; it is now covered with a stand of chamisa and weeds. No sign of TA-14-11 remains. The site is contoured so that it drains toward the north ditch that borders the entrance road to the site.

5.3.3 Conceptual Exposure Model

5.3.3.1 Nature and Extent of Contamination

The PRSs in this aggregate include both active and decommissioned structures. All are suspected of being contaminated with HE residues and degradation products, radionuclides, and metals. One of the former structures [SWMU 14-002(a)] had an associated floor drain and another was a sump (SWMU 14-010), suggesting presence of subsurface contamination. A 1987 DOE environmental survey indicated the presence of detectable radioactivity at the ruptured sandbags (SWMU 14-009). On June 25, 1993, field spot-test kits were used to survey for explosives in the vicinity of the bullet test facility [SWMU 14-001(f)]. Some questionable positive results were obtained, which were described by the investigators as possible false positives (Harris 1993, 21-0082). No quantitative information is available regarding possible residual contamination at any remaining structures.

5.3.3.2 Potential Pathways and Exposure Routes

The conceptual exposure model is presented in Figure 5-6. A summary of exposure mechanisms and human receptors is presented in Table 5-8.

The terrain in the vicinity of these SWMUs is relatively flat but slopes to the south toward the canyon. There are visible drainages. Surface water run-off is considered to be a major pathway of concern. If the surface water infiltrated the SWMU, it could also have transported contaminants into the sediments and soil in the drainages. Contaminated sandbags that were damaged in firing experiments were spread for erosion control at the site (SWMU 14-009). Wind dispersion of surface contaminants may also have occurred.

Radiological decay has occurred; but, due to the long half-lives of the uranium isotopes, decay is not a significant removal mechanism for this isotope. Lanthanum-140 sources with associated strontium-90 contamination may also have been used in experiments. The lanthanum has completely decayed away, but a significant fraction of any strontium-90 may still be present because of its approximate 29-year half-life (see Subsection 5.2).

A more detailed description of the migration pathways, conversion mechanisms, potential receptors, exposure pathways, and exposure assumptions relevant to the entire OU is presented in Chapter 4.

5.3.4 Remediation Decisions and Investigation Objectives

5.3.4.1 Problem Statement (DQO Step 1)

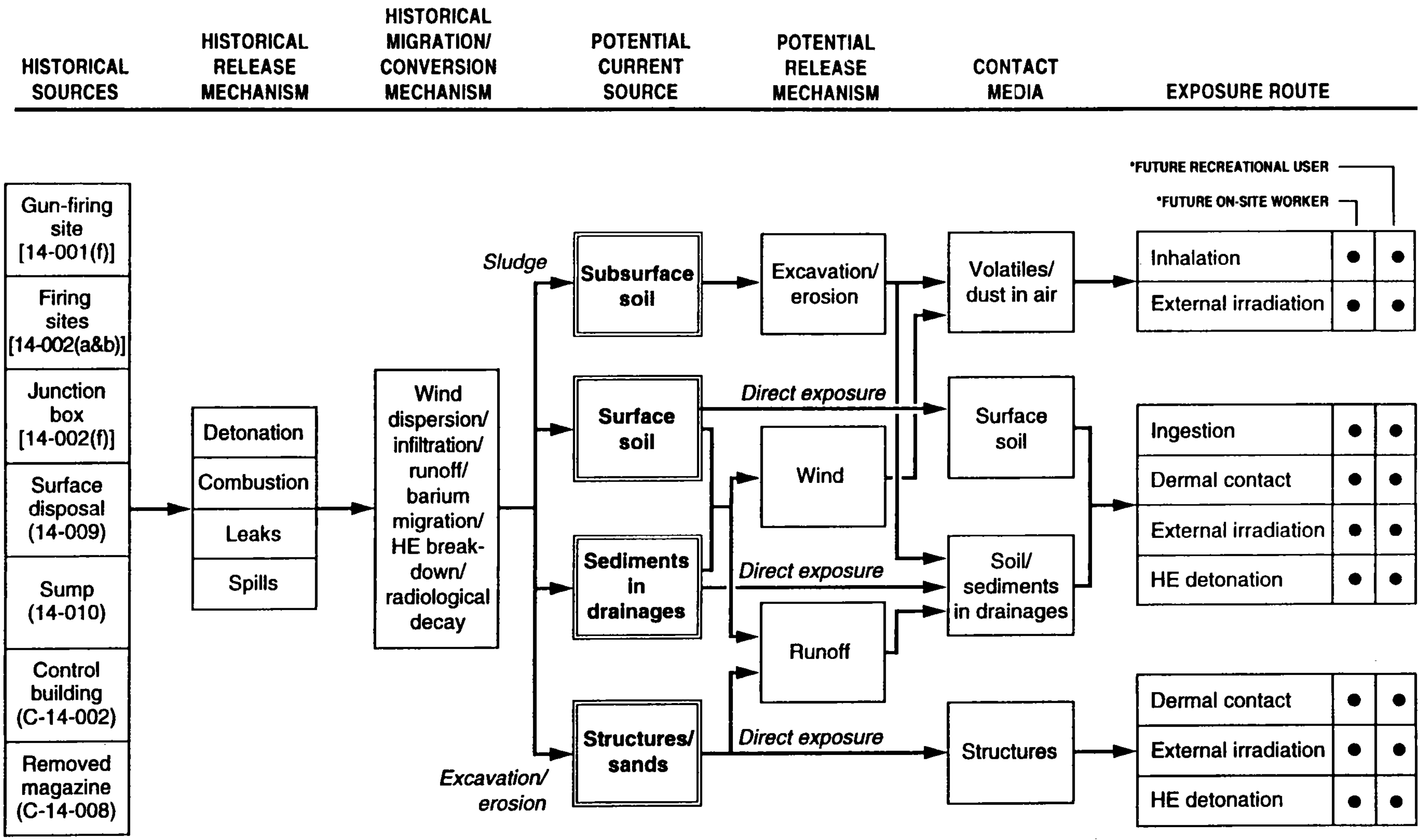
The PRSs associated with the western area aggregate include integral components of an active firing site. If work is continued at this site, it can be expected to affect the active PRSs and drainages included in this aggregate. Any current risks to on-site workers are the responsibility of the active operational groups and will not be addressed in the RFI. Active-site SWMUs will not be remediated until the site is decommissioned. The main investigation centers around possible contaminant migration down the south drainages from the firing site

Although the closest point for public exposure is at the intersection of Water Canyon and State Road 4 near White Rock (Figure 1-3), interim actions to stop or reduce off-site migration, such as

TABLE 5-8

Aggregate 3: Western Area at TA-14 Exposure Mechanisms and Receptors

PRS	POTENTIAL AREA OF CONTAMINATION	RELEASE MECHANISM	CURRENT POTENTIAL RECEPTORS	FUTURE POTENTIAL RECEPTORS
14-001(f), 14-002(a), 14-002(b), 14-002(f), 14-009, C-14-002, C-14-008	Surface soil and sediments in drainages	•Wind dispersion •Surface water runoff and infiltration •External irradiation	On-site workers	Recreational users, on-site workers
14-009	Sand from sandbags	•Surface water runoff •External irradiation	On-site workers	Recreational users, on-site workers
14-002(a) (floor drain), 14-010	Subsurface soil	Excavation or erosion resulting in surface release mechanisms	On-site workers	Recreational users, on-site workers
14-001(f)	Structures	•Excavation or erosion exposing structures •Surface water runoff and infiltration •External irradiation	On-site workers	Recreational users, on-site workers



• No current receptors have been identified

Figure 5-6. Conceptual exposure model for Aggregate 3—TA-14: Western Area at TA-14.

the removal of contaminated sediments and/or the placement of barriers, will be based on samples collected in the sediment catchments in the southern drainages.

5.3.4.2 Decision Process (DQO Step 2)

To determine if off-site migration presents a potential health problem, we will compare potential contaminant levels in sediments in the drainages with SALs (see Chapter 4 and IWP Subsections 4.2.2 and Appendix J (LANL 1993, 1017). If the SALs are exceeded, then a baseline risk assessment will be carried out and potential contaminant levels in sediments in the tributary will be used to calculate whether or not acceptable risk levels are exceeded for a site-specific scenario. Public exposure is not an issue here; however, if levels correspond to unacceptable risk levels for a recreational-use scenario, then an interim action to stop migration will be evaluated.

Evaluation of a safety hazard will also be based on the presence of unexploded HEs in the drainages. If fragments of unexploded HEs are found in the tributary or if the concentration of HEs in the sediment catchments of the tributary are determined to be above acceptable safety levels, then an interim action will be evaluated. The acceptable safety levels for amount and particle size have not been determined. It is the responsibility of Dynamic Experimentation Division (DX Division) to set acceptable safety limits for HE fragments.

5.3.5 Data Needs and Data Quality Objectives

5.3.5.1 Decision Inputs and Investigation Boundary (DQO Steps 3 and 4)

The potential public health risk is from off-site migration of potential contaminants. As stated previously, the major route for potential off-site migration is the drainage to Cañon de Valle. Sediment catchments in this tributary provide an estimate of the maximum concentrations of PCOCs downstream of the firing site.

If deferred action for this aggregate is proposed, the decision will be based on PCOC concentrations in the sediment catchments. If pieces of HE are encountered, then this work plan will be adapted to include a VCA similar to that described for PRS 12-001(b) in section 5.1.

A secondary goal of the Phase I survey will be to provide data that will help LANL plan any Phase II survey, if it is needed. Data collected on PCOC concentrations in the north and south drainages will help design the Phase II migration rate survey.

The data required for these assessments are measurements of potential contaminant concentrations and HE particle size distributions and concentrations in the sediment catchment drainages.

5.3.5.2 Decision Logic (DQO Step 5)

Screening assessment decision rules are stated for each PRS or aggregate (off-site migration) in terms of the maximum observed concentration of each PCOC. If the maximum concentrations of any potential contaminant in the sediment catchments in the drainage to Cañon de Valle are above the SALs and background or if a safety hazard exists, then Phase II sampling will be required to determine the maximum extent of migration. After Phase II sampling is complete, an interim action will be taken to mitigate contaminant migration. If the PCOC concentrations are below SALs in the drainage catchments, then deferred action may be proposed.

Some adjustments are made to this decision rule to account for PCOCs for which SALs are less than the normal range of background (e. g. beryllium), or if several PCOCs exhibit concentrations which are close to SALs without actually exceeding them. Chapter4 Subsection 4.1.4 and Appendix J of the IWP (LANL 1993, 1017) provide details of the effect of these adjustments on the decision rule.

5.3.5.3 Design Criteria (DQO Step 6)

Screening assessment sampling will be used for the sediments catchments in the drainage to Cañon de Valle. The catchments are expected to have collected PCOCs and should provide an upper boundary to PCOC concentrations.

We assume that if potential contaminants have reached the drainage to Cañon de Valle, they will be detectable in at least one of the two drainages that flow to the canyon. The primary PCOCs for this study are HEs. All drainage samples will be analyzed for HEs (both by laboratory analytic measurement on the sieved soil sample and by a safety screen on the complete field sample) and other PCOCs.

Sediment catchments in the western and eastern drainages will be sampled for HEs to evaluate the pattern of contaminant migration. These data will help design a Phase II survey, if it is needed. All samples will be screened to see if they meet health and safety requirements. Appropriate transport and laboratory safety procedures, based on the field screening data will be implemented.

5.3.6 Phase I Sampling and Analysis Plan

Phase I sampling will focus on determination of the presence or absence and extent of PCOCs above SALs. A Phase II sampling plan, if necessary, will further define the nature, extent, and rate of migration of any release identified in Phase I. Refer to Appendixes C, Introduction to High

Explosives; Appendix D, Maps; and Appendix E, Field and Laboratory Investigation Methods; For additional OU 1085 field sampling information, including SOPs used in this sampling plan.

Field Screening. All samples will be field-screened for gross alpha, beta, and gamma to detect the presence of radionuclides. The HE spot test will be used to detect the presence of HEs.

Appropriate health and safety precautions will be undertaken according to the Laboratory's ER Program SOPs (LANL 1993, 0875).

5.3.6.1 Engineering Surveys

Engineering surveys will locate, stake, and document PRS boundaries, the areas for HE and radiation surveys, surface sampling, and all surface engineering and geomorphological features. All sample locations will be registered on a base map, scale 1:1200. If any sample points must be relocated during the course of sampling, the new position will be surveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional surveyor under the supervision of the field team leader.

5.3.6.2 Sampling

5.3.6.2.1 Sampling Rationale

Aggregate 3 comprises seven decommissioned and one active PRSs within an active site. Therefore, sampling of SWMUs 14-001(f), 14-002(b), 14-009, 14-002(a), 14-002(f), 14-010, C-14-002, and C-14-008 will be deferred until the site is decommissioned. However, drainage sampling will be performed to detect any PCOCs migrating off-site by way of the eastern and western drainage channels.

5.3.6.2.2 Sampling Techniques

Surface soil samples will be gathered with the spade and scoop or with ring sampler technique to a depth of 6 in. The specific technique will be determined by the field team leader.

See Figure 5-7 for planned sample locations and Table 5-9 for a listing of planned sampling. Locations were chosen after a field visit to the site that reflects the topography of the drainage.

5.3.6.2.3 Western Area at TA-14 Aggregate Sampling

Eight surface soil samples will be collected to ensure that PCOCs have not migrated down the drainages on the southeastern and southwestern sides of the TA-14 western area (four samples in each drainage). These samples will verify that PCOCs are or are not leaving the TA-14 site. The spade and scoop or ring sampler methods will be used to collect samples in the drainages.

Analytical samples taken as part of the western firing site aggregate will be evaluated initially for HE amount and particle size and then will be analyzed for HEs, radionuclides, and metals. Refer to Table 5-9 for a complete list of PCOCs.

5.3.6.3 Fixed Base Laboratory Analyses

Fixed base laboratory analyses for radionuclides, HEs, and metals will be based upon the following methods: LANL or DOE methods for alpha, beta, and gamma spectrometry, SW-846

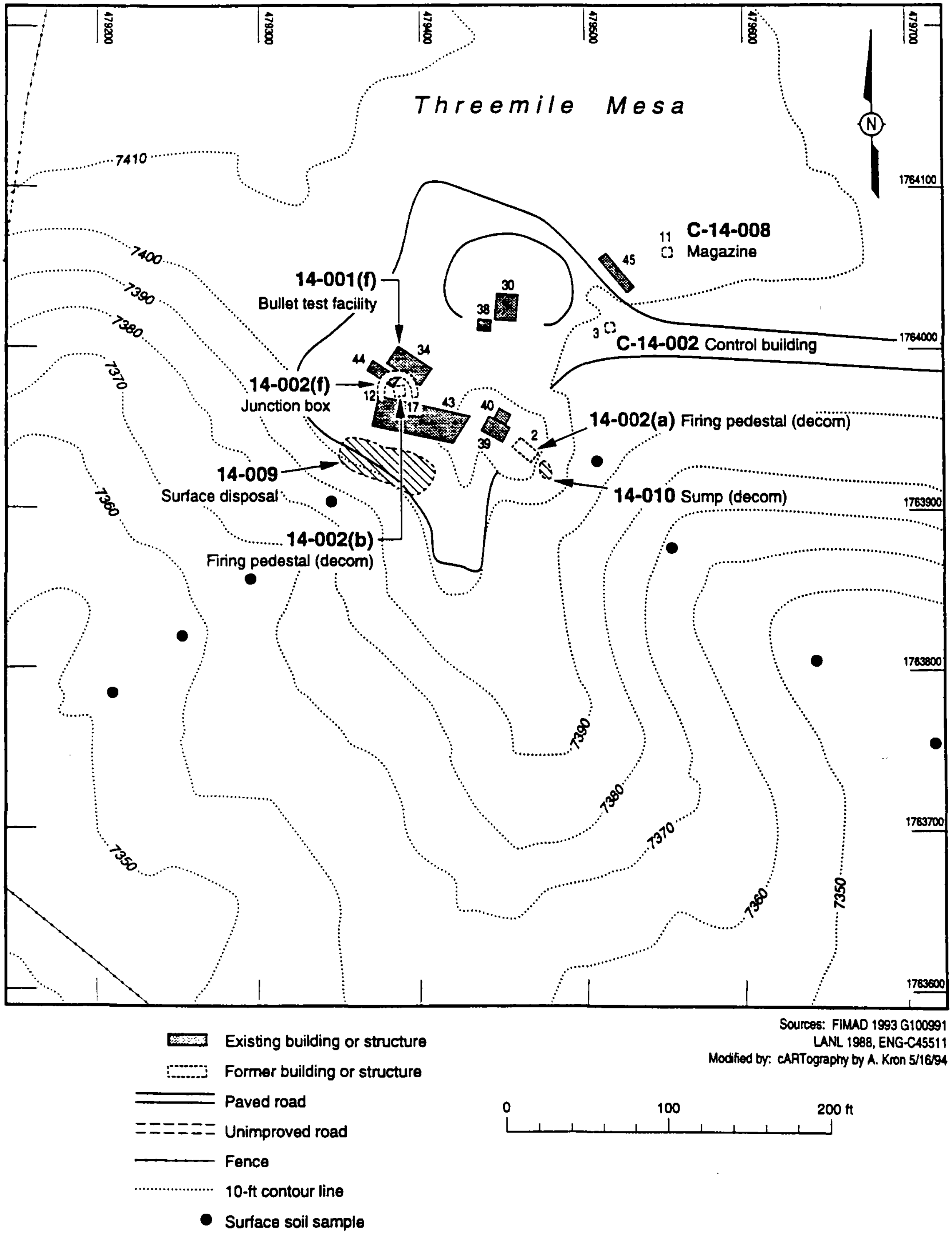


Figure 5-7. Sampling locations in Aggregate 3—TA-14: Western Area.

Table 5-9
Sample Analysis for Aggregate 3

						Field Survey					Field Screening			Laboratory Analyses				
PRS	Prs Type	Phase 1 Approach	Sample Media	Samples	Duplicates	Land Survey	Geophysics	High Explosives	Polynuclear Aromatic Hydrocarbons	Radiation	Gross Beta/Gamma	High Explosives	Organic Vapor	Gamma Spectroscopy	High Explosives	Isotopic Uranium	Metals	Semivolatiles
Aggregate 3	Offsite Migration	Screening Assessment	Soil	8	1	X		X		X	x			x	x	x	x	x

method 6010 for metals, SW-846 method 8270 for semivolatiles, and SW-846 method 8330 for HEs and HE degradation products. The principle radionuclide of concern is uranium-235; the principal semivolatile organic compounds (SVOCs) of concern are HEs and HE by-products and detonation products. The metals of concern are beryllium, lead, and uranium.

5.3.6.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the latest revision of the IWP (LANL 1993, 1017). The QA/QC duplicate samples planned to be collected during the course of the field investigation are outlined in Table 5-9.

5.4 Central Area at TA-14 - Aggregate 4: SWMUs 14-001(a,c) and 14-006; and AOCs C-14-003, C-14-004, C-14-005, C-14-006, and C-14-007

5.4.1 Background

The central TA-14 aggregate consists of SWMUs that are integral components of the active firing site operations at TA-14 (Q-Site). Small amounts of HE and metals from years of conducting explosive tests have contributed to possible surface contamination that could extend to the surrounding area for several hundred feet. SWMUs grouped in this aggregate contain potential surface and near-surface contamination from past activities and potential surface contamination from current activities. Figure 1-6 shows the PRSs of Aggregate 4.

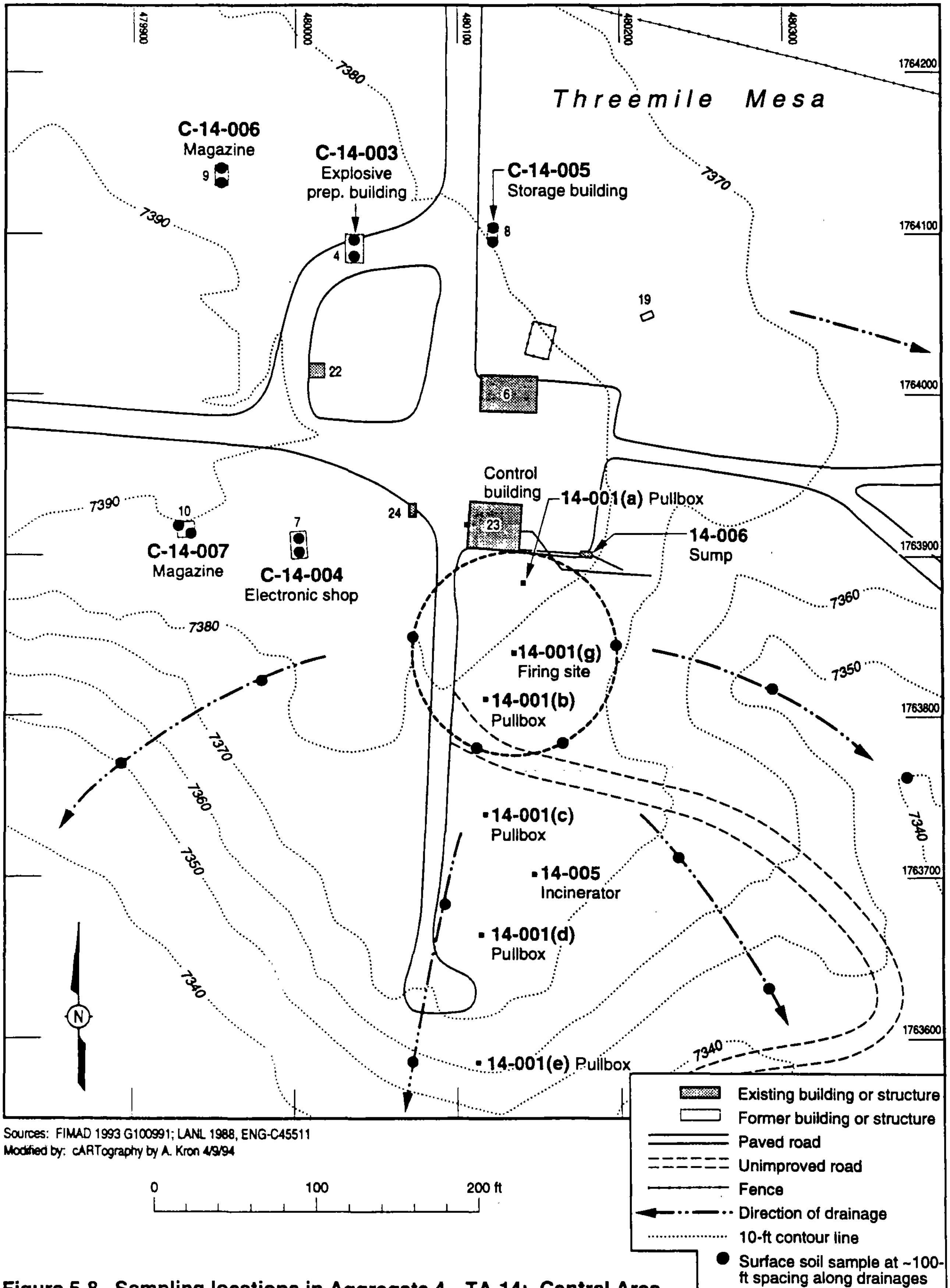
The reason for aggregating these SWMUs is that they are either active or close to active sites and will not be remediated until the technical area is decommissioned. Surface soil will be sampled in the surrounding drainages to determine whether potential contaminants have migrated from the source area. If necessary, an interim action to prevent off-site migration resulting from past contamination activities will be implemented to protect human health.

5.4.2 Description and History

TA-14 is located 3 miles east of TA-9 and 0.5 mile west of TA-15 on the R-Site Road. It is situated on the southern edge of Threemile Mesa. The central TA-14 firing site is 190 ft wide east to west at the top (northern part) and 400 ft long from north to south (Figure 1-6). It slopes to the south for most of its area then drops approximately 30 ft into Cañon de Valle. As with all firing sites, the area has been scraped clear of vegetation to prevent fires from the high explosive tests. The area surrounding the firing site is highly vegetated.

This aggregate includes several buildings constructed in late 1944 and early 1945. These included a control room (TA-14-23), an experimental preparation building (TA-14-4), storage buildings and magazines (TA-14-8, TA-14-9, and TA-14-10), an electronics shop (TA-14-7), and a shop and dark room (TA-14-6) (LANL 1993, 21-0077). All buildings removed in March 1952. The locations of all the removed buildings are on a 1950 Laboratory photograph (11547). The removed buildings are part of this aggregate because they had the same possible contaminant, high explosives, and are closely located to active PRSs in the central part of TA-14.

The site has four drainages. In the upper third of the site, there is a drainage to the east; in the middle of the site the next drainage also flows to the east; the third drainage is from the lower portion of the site to the south; and the last drainage from the lower portion of the site flows to the southwest as shown by arrows in Figure 5-8. All of these drainages flow into the Cañon de Valle,



Sources: FIMAD 1993 G100991; LANL 1988, ENG-C45511
Modified by: cARTography by A. Kron 4/9/94

Figure 5-8. Sampling locations in Aggregate 4—TA-14: Central Area.

which contains an intermittent stream. These drainages will be sampled to check for possible contaminants leaving the site.

Construction of current buildings and structures in the central part of TA-14 began in the early 1950s under the direction of Group GMX-2, Explosives Research and Development. This group evolved into Group WX-2, Explosives and Other Materials Development in 1972, and Group M-1, Explosive Technology, in 1982. Group M-1 still runs the site. For example, TA-14-23, the control building, was finished in late 1952 (LANL 1993, 21-0077). Other buildings such as magazines, pullboxes, and firing pads were constructed at the same time. A large number of types of explosives tests are performed, including gap tests, plate-dent tests, and tests to determine HE deteriorations. Gap tests often yield low-order detonations, so HE fragments are likely to be found.

Explosives used in shots at this site included pentolite, torpex, tamped tetryl, Composition B, baratol, and TNT. Lead was involved in the early shots. Several shots involving radioactive lanthanum, which has now decayed, were also made. The lanthanum was contaminated with strontium-90 but the extent of strontium-90 contamination in these shots is not known. Uranium and beryllium were also used in shots (LANL 1990, 0145).

The following PRSs resulted from firing activities at the site and are summarized in Table 5-10. As individual PRSs they are all recommended for DA or NFA.

SWMUs 14-001(a-e): Central TA-14. These five SWMUs are small structures (26 in. long by 32 in. wide by 32 in. deep) that are known as pullboxes and also as pits. A pit holds a capacitor discharge unit (CDU) located next to a firing pad. All of these CDUs are in active use. The corresponding structure numbers for SWMUs 14-001(a-e) are, respectively, TA-14-25, -26, -27, -28, and -29 and will be considered for DA.

SWMU 14-001(g). This SWMU is an active firing site and will therefore be recommended for DA (see § 5.4.7.2).

SWMU 14-006. This SWMU consists of a sump, associated drain line, and unpermitted outfall for TA-14-23. The sump (TA-14-31) is a steel and concrete unit (4.5 ft wide by 8.3 ft long by 4.8 ft deep) used to separate small pieces of HE from liquid. The sump is now plugged and the only discharge to the outfall is rainwater. Sludge in the sump is picked up for burning. A drain in the control building (TA-14-23) is connected to the sump as shown in Engineering drawing R-109. The waste consists of sludge from HE-contaminated wash water. The sump, filter, and drain are probably contaminated with HE (LANL 1990, 0145). An outfall line extends to the southeast about 20 ft and drains down a small embankment.

TABLE 5-10

PRSs in the Central Area at TA-14

PRS	STRUCTURE NUMBER	DESCRIPTION	RECOMMEND-ATION	SECTION
14-001(a)	TA-14-25	Capacitor discharge units (pullbox)Active	DA	6.4.1
14-001(b)	TA-14-26	Capacitor discharge unit (pullbox)	DA	6.4.1
14-001(c)	TA-14-27	Capacitor discharge unit (pullbox)	DA	6.4.1
14-001(d)	TA-14-28	Capacitor discharge unit (pullbox)	DA	6.4.1
14-001(e)	TA-14-29	Capacitor discharge unit (pullbox)	DA	6.4.1
14-001(g)		Firing site (Active DA)	DA	6.2.1
14-005		Incinerator	DA	6.1.1
14-004(a)		Satelite storage area	NFA	6.2.3.1
14-004(c)		Satelite storage area	NFA	6.2.3.1
14-006	TA-14-31	Sump	Investigate	6.4.1
C-14-003	TA-14-4	Explosive preparation building	Investigate	6.4.1
C-14-004	TA-14-7	Electronics shop	Investigate	6.4.1
C-14-005	TA-14-8	Storage building	Investigate	6.4.1
C-14-006	TA-14-9	Magazine	Investigate	6.4.1
C-14-007	TA-14-10	Storage building	Investigate	6.4.1

This table was taken from 5.4.1.1

C-14-003: TA-14-4. This decommissioned HE-preparation building was located north of current magazine TA-14-22 in the central part of TA-14, within the loop made by the paved road circling the magazine. It was of wooden construction 12 ft wide by 25 ft long by 8 ft high. No sign of the building remains. The site lies in an unpaved area lightly covered with grasses and weeds on the sloping side of the berm from magazine TA-14-22. The shot preparation building was built in October 1944 and removed in March 1952 (LANL 1993, 21-0077).

C-14-004: TA-14-7. This decommissioned electronics shop was located 75 ft west of building TA-14-23, in the central part of TA-14. It was of wooden construction 15 ft wide by 24 ft long by 9 ft high. The terrain slopes gently to the south and is covered with grasses and a few low shrubs. To the west are oak thickets and pine forest. Runoff is toward the ditch bordering the graveled road serving the firing area. All that remains of building TA-14-7 is the concrete foundation and the concrete stoop at the north end. The electronics shop was built in January 1945 and removed in March 1952. (LANL 1993, 21-0077) .

C-14-005: TA-14-8. This decommissioned storage building was located on the east side of the access road to TA-14, 80 ft north of building TA-14-6 in the central part of TA-14. It was of wooden construction 16 ft long by 6 ft wide by 9 ft high. The area is nearly level, only slightly sloping to the north, and covered with grasses and weeds. Drainage leads into the ditch at the side of the road, then north to the R-Site Road drainage system. With the possible exception of a few chips of concrete, no signs of the building remain. This storage building was built in December 1944 and removed in March 1952 (LANL 1993, 21-0077).

C-14-006: TA-14-9. This decommissioned magazine is located 30 ft northwest of current magazine, TA-14-22, in the central part of TA-14 . It was of wooden construction 6 ft long by 6 ft wide by 6 ft high with a soil berm on three sides and the top. The area is in a level field with pine forest to the north and west. The site is covered with loose fill, possibly resulting from leveling the berm that surrounded the magazine. Weeds and grasses cover the area. An asphalt road that circled the magazine is still visible. Drainage is to the northeast into the ditches lining the west sides of the paved roads. The location of C-14-006 has been determined from a LANL photograph (15947) taken in 1950. This structure was constructed in January 1945 and was removed in March 1952 (LANL 1993, 21-0077).

C-14-007: TA-14-10. This decommissioned storage building was located in the central part of TA-14, 160 ft west of TA-14-23, near the rim of the breaks leading south down to Cañon de Valle. It was of wooden construction 10 ft long by 10 wide by 8 ft high. The area is forested and covered with grasses and pine duff; the building footprint is overgrown by pines and oak brush. The terrain slopes to the south toward a low, rocky cliff. All that remains of TA-14-10 is a small pile of bricks with mortar attached to their sides. There is no obvious leveling of the site and no other debris. Measurements from photos and old maps indicate the location of TA-14-10. A trace of a gravel road passes the site and leads to the TA-14-7 foundation, as shown on Engineering drawing R-129 and Sandia Laboratory photo 46-1030-12. This building was constructed in January 1945 and was removed in March 1952 (LANL 1993, 21-0077).

5.4.3 Conceptual Exposure Model

5.4.3.1 Nature and Extent of Contamination

These PRSs are current or former structures used for various functions associated with firing experiments. Except for SWMUs 14-001(a-e) which are enclosed boxes, they are suspected of being contaminated with HE residues and degradation products, radionuclides, and metals. The contamination is suspected of being confined to the surface, with the possible exception of the area near the sump (SWMU 14-006), which may have associated subsurface soil contamination. It is assumed that debris from the tests was scattered for several hundred feet in all directions from HE firing sites. Signs present in the area indicate that the soil is contaminated with uranium-238. Site workers periodically clean up the larger pieces of debris that are scattered as a result of tests.

On June 9, 1988, six surface (0 to 6 in.) samples were collected from the central area at TA-14 as a part of a survey known as "Environmental Problem 2" dealing with burn areas. The samples included ash from the incinerator (SWMU 14-005) and soil from a former trash pile which was located 234 ft south of the control building. Analysis for metals indicated that the SALs were exceeded for beryllium, chromium (as chromium IV), copper, arsenic, and lead in one or more samples. Analysis of samples from the incinerator burn area indicated the presence of a number of semivolatiles. Of these chemicals, most were at least one order of magnitude below SALs. However, the following semivolatiles exceeded the SALs: benzo(a)pyrene, chrysene, ideno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene. Of the chemicals that exceeded the SALs, all were in one sample which is suspected of containing a large percentage of ash and is therefore not representative of the soil contamination at the site. The ash was subsequently removed and any new ash produced is collected for proper disposal. There were also four semivolatiles detected for which there currently are no SALs available. TNT was the only high explosive compound detected, and it was only detected in one of the samples. However, the concentration was above the SAL. Gamma screens of the samples indicated the presence of naturally occurring radionuclides as well as small amounts of uranium-235 and cesium-137, at levels below their SALs (LANL 1989, 0425).

In 1993, sampling at TA-14 was done as a part of a program to characterize soil and water contamination at active RCRA firing sites.

On June 24, 1993, field spot-test kits were used to survey for explosives at the first firing pad (nearest the control building). Results indicated "very low" quantities of TNT in the soils around the pad. In the spot-test report (Harris 1993, 21-0082), results of the laboratory analysis of soil samples from firing pads 1, 2, and 3 were also presented. Samples were analyzed for cyclotetramethylene-tetranitramine (HMX), RDX, N-methyl-N,2,4,6-tetranitrobenzeneamine (tetryl), TNT, and dinitrotoluene (2,4-DNT). Soil contamination above the detection limit was found for HMX, RDX, and TNT. However, none of the samples was above SALs. The soils from firing pad 3 were also analyzed for picric acid since this area was suspected of being contaminated with this compound when a shot designed to dispose of waste explosives failed to detonate. All results were less than the detection limit. Metals analysis for chromium, mercury, lead, and uranium were also performed on the samples from all three firing pads. With the exception of uranium in one sample, all results were below SALs (Harris 1993, 21-0082).

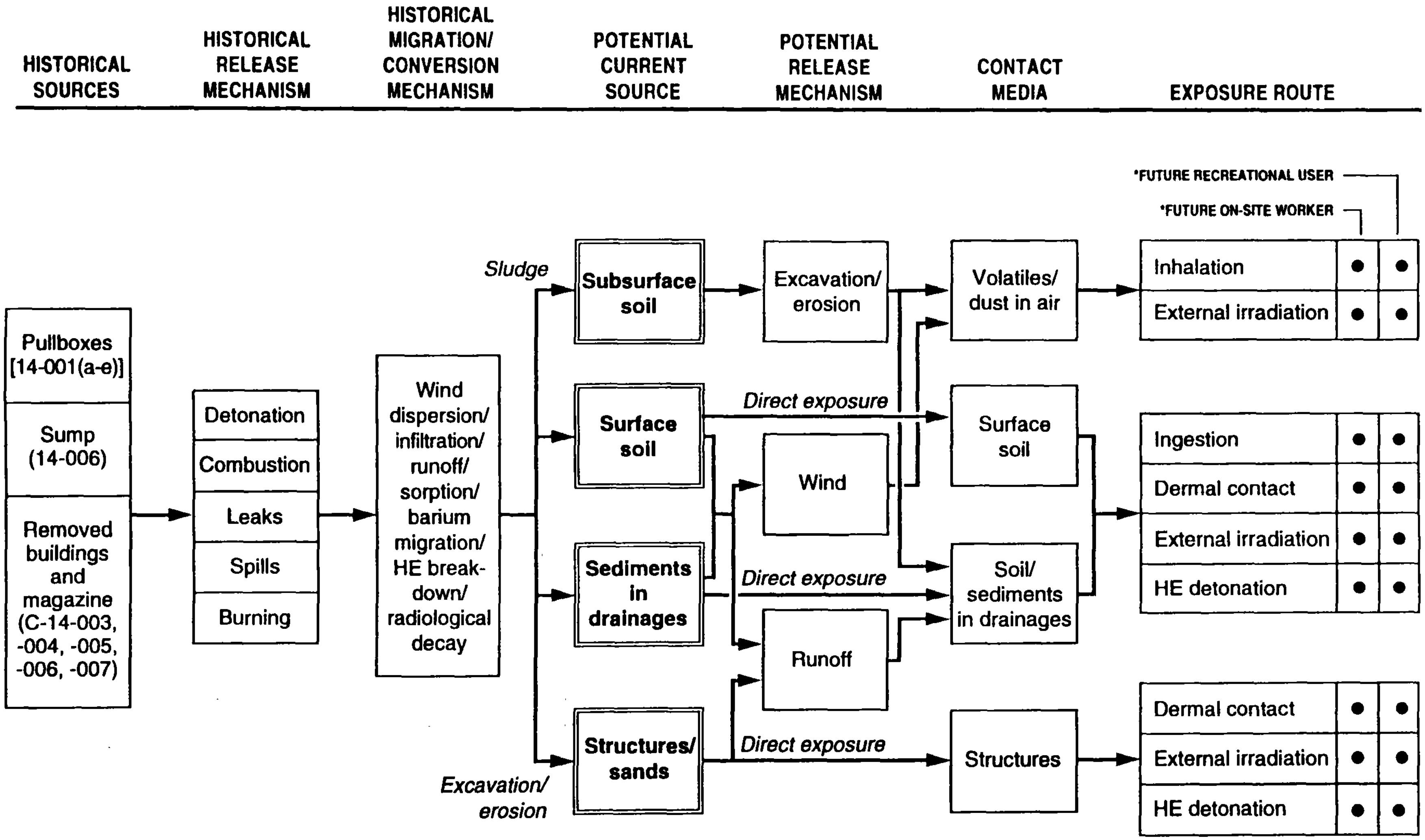
With the exception of C-14-003, some debris marks the former locations of the removed buildings. No quantitative information is available on the possible residual contamination as a result of activities conducted in the former structures.

5.4.3.2 Potential Pathways and Exposure Routes

The conceptual exposure model is presented in Figure 5-9. A summary of exposure mechanisms and human receptors is presented in Table 5-11.

The terrain in the vicinity of the SWMUs is relatively flat up to the southernmost firing point, which is on a plane approximately 29 ft lower than the rest of the site. The upper part of the site drains to the east, and the lower part drains to the south. All of the drainages flow into the canyon to the south. Surface water runoff is considered to be a major pathway. Infiltration of surface water could also have transported contaminants into the sediments and soil in the drainages. Wind dispersion of surface contaminants may also have occurred.

The terrain in the vicinity of the AOCs is gently sloping, and there are a few visible drainage channels draining to roadside ditches, providing surface water runoff pathways. Infiltration of surface water could also have transported contaminants into the sediments and soil in the drainages, as well as into the soil beneath the footprints of the former structures. Wind dispersion of surface contaminants may also have occurred.



* No current receptors have been identified

Figure 5-9. Conceptual exposure model for Aggregate 4—TA-14: Central Area.

TABLE 5-11

Aggregate 4: Central Area at TA-14 Exposure Mechanisms and Receptors

PRS	POTENTIAL AREA OF CONTAMINATION	RELEASE MECHANISM	CURRENT POTENTIAL RECEPTORS	FUTURE POTENTIAL RECEPTORS
14-006, C-14-003, C-14-004, C-14-005, C-14-006, C-14-007	Surface soil and sediments in drainages	•Wind dispersion •Surface water runoff and infiltration •External irradiation	On-site workers	Recreational users, on-site workers
14-001(g), 14-005, C-14-006	Debris	•Surface water runoff •External irradiation	On-site workers	Recreational users, on-site workers
14-006	Subsurface soil	Excavation or erosion resulting in surface release mechanisms	On-site workers	Recreational users, on-site workers
14-006	Sludge in sump	•Leaks to surrounding subsurface soils •External irradiation	On-site workers	Recreational users, on-site workers
14-001(a-e), 14-006	Structures	•Excavation or erosion exposing structures •Surface water runoff and infiltration •External irradiation	On-site workers	Recreational users, on-site workers

Radiological decay has occurred; but, due to the long half-lives of uranium isotopes, decay is not a significant removal mechanism for them. Lanthanum-140 sources with associated strontium-90 contamination may also have been used in experiments. The lanthanum has completely decayed away, but a significant fraction of any strontium-90 may still be present due to its approximate 30 year half-life (see Subsection 5.2).

A more detailed description of the migration pathways, conversion mechanisms, potential receptors, exposure pathways, and exposure assumptions relevant to the entire OU are presented in Chapter 4.

5.4.4 Remediation Decisions and Investigation Objectives

5.4.4.1 Problem Statement (DQO Step 1)

The PRSs associated with the TA-14 central area firing site aggregate include integral components of an active firing site. Continuing work at this site can be expected to affect the active PRSs and drainages included in this aggregate. Any current risks to on-site workers are the responsibility of the active operations and will not be addressed in the RFI. Active SWMUs will not be remediated until the site is decommissioned. Buried PRSs present no current risk to the public or on-site workers and also will not be remediated until decommissioning of the site. The principal problem is to investigate contaminant migration down the drainages from the firing site to Cañon de Valle. However, AOCs C-14-003, C-14-004, C-14-005, C-14-006, and C-14-007 may be investigated without interfering with the activities of the site. Thus, the DQO process will mirror that of the AOCs presented in Section 5.1.

Although the closest point for public exposure is at the intersection of Water Canyon and State Road 4, near White Rock (Figure 1-2), interim actions to stop or reduce off-site migration, such as the removal of contaminated sediments and/or the placement of barriers, will be based on samples collected in the sediment drainages.

5.4.4.2 Decision Process (DQO Step 2)

To determine if off-site migration presents a potential health problem, potential contaminant levels in sediments in the drainages from the firing site will be compared to SALs (see Chapter 4 and IWP Subsections 4.2.2 and Appendix J (LANL 1993, 1017). If the SALs are exceeded, then a baseline risk assessment will be carried out and potential contaminant levels in sediments in the tributary will be used to calculate whether or not acceptable risk levels are exceeded for a site-specific scenario. Although public exposure is not an issue at this location, if levels correspond to unacceptable risk levels for a recreational-use scenario, then an interim action to stop migration will be evaluated.

Evaluation of a safety hazard will be based on the presence of unexploded HE in the drainages. If fragments of unexploded HE are found in the drainages, or if the concentration of HE in the sediment catchments of the tributary are determined to be above acceptable safety levels, then an interim action will also be evaluated. The safety levels for amount and particle size that is acceptable from a safety perspective have not been determined. It is the responsibility of DX Division to set acceptable safety limits for HE fragments.

5.4.5 Data Needs and Data Quality Objectives

5.4.5.1 Decision Inputs and Investigation Boundary (DQO Steps 3 and 4)

The potential public health risk is from off-site migration of potential contaminants. As stated previously, the major route for potential off-site migration is drainages. Sediment catchments in this tributary provide an estimate of the maximum concentrations of PCOCs downstream of the firing site.

The decision to propose deferred action for this aggregate will be based on PCOC concentrations in the sediment catchments. If necessary, these data will be used in the baseline risk assessment. If pieces of HE are encountered, then this work plan will be adapted to include a VCA similar to that described for PRS 12-001(b) in Section 5.1.

A secondary goal of the Phase I survey will be to provide data that will help plan a Phase II survey, if it is needed. Data collected on PCOC concentrations in the drainages will help design any Phase II migration rate survey.

The data required for these assessments are measurements of potential contaminant concentrations and HE particle size distributions and concentrations in the sediment catchments of the drainages.

5.4.5.2 Decision Logic (DQO Step 5)

Screening assessment decision rules are stated for each PRS or aggregate (off-site migration) in terms of the maximumobserved concentration of each PCOC. If the maximum concentrations of any potential contaminant in the sediment catchments in the tributary to Water Canyon are above SALs or if a safety hazard exists, then Phase II sampling will be required to determine the maximum extent of migration. After Phase II sampling is complete, an interim action will be taken to mitigate contaminant migration. If the PCOC concentrations are below SALs in the drainages, then deferred action may be proposed.

Some adjustments are made to this decision rule to account for PCOCs for which SALs are less than the normal range of background (e.g.beryllium), or if several PCOCs exhibit concentrations that are close to SALs without actually exceeding them. Chapter 4 Subsection 4.1.4 and Appendix J of the IWP (LANL 1993,1017) provide details of the effect of these adjustmants on the decision rule.

5.4.5.3 Design Criteria (DQO Step 6)

Screening assessment sampling will be used for the sediments catchments in the drainages. The catchments are expected to have collected PCOCs, and should provide an upper bound to PCOC concentrations.

It is assumed that if potential contaminants have reached the drainages, they will be detectable in one or more of the three drainages that flow to Cañon de Valle. The primary PCOC for this study is HE. All samples in the drainages will be analyzed for HE (both laboratory analytical measurement on the sieved soil sample and a safety screen on the complete field sample) and other PCOCs.

Sediment catchments in the three drainages will be sampled for PCOCs to evaluate the pattern of contaminant migration. These data will help design a Phase II survey, if it is needed. All samples will be screened to see if they meet health and safety requirements. Appropriate transport and laboratory safety procedures will be implemented based on the field screening data.

5.4.6 Phase I Sampling and Analysis Plan

Phase I sampling will focus on determining the presence or absence of PCOCs above SALs and of HE chunks. A Phase II sampling plan, if necessary, will further define the nature, extent, and rate of migration of any release identified in Phase I. Refer to Appendixes D and E, and Annex II for additional OU 1085 field sampling information including SOPs used in this sampling plan. These appendixes are: Appendix E, Field Investigation Approach and Methods, and Appendix D, OU 1085 Maps and Annex II, Quality Assurance Project Plan.

Field Screening all samples will be field screened for gross alpha, beta, and gamma to detect the presence of radionuclides. The HE spot test will be used to detect the presence of HE.

Appropriate health and safety precautions will be undertaken according to the Laboratory's ER Program SOPs (LANL 1993, 0875).

5.4.6.1 Engineering Surveys

Engineering surveys will locate, stake, and document PRS boundaries, the areas for HE and radiation surveys, surface sampling, and all surface engineering and geomorphic features. All sample locations will be registered on a base map, scale 1:1200. If during the course of sampling any sample points must be relocated, the new position will be resurveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

5.4.6.2 Sampling

5.4.6.2.1 Sampling Rationale

The Central Area at TA-14. One sample from each of the SWMUs 14-001(a), 14-001(b), 14-001(c), 14-001(d), and 14-001(e), will be taken even though this is an active site and could be deferred until decommissioning, since it is very likely they can then be recommended for NFA. However drainage sampling will be performed to detect any PCOCs migrating off-site to the south by way of the four drainage channels.

PRSs C-14-003, C-14-004, C-14-005, C-14-006, and C-14-007 will be sampled in a manner consistent with that outlined for the AOCs in Section 5.1. This consists of taking two samples from each area and analyzing as shown in Table 5-12. Samples will be biased on HE and/or radiation screening as appropiate.

5.4.6.2.2 Sampling Techniques

Surface soil samples will be gathered with either the spade and scoop or ring sampler technique to a depth of 6 in. The specific technique will be determined by the field team leader.

See Figure 5-8 for planned sample locations and Table 5-12 for a listing of planned sampling.

5.4.6.2.3 Sampling Summary

Central Area at TA-14 Aggregate Sampling. Twelve surface soil samples will be collected to ensure that PCOCs have not migrated down the drainages on the southern, southeastern, and southwestern sides of the TA-14 central firing site. These samples will verify that PCOCs are not leaving the TA-14 site. The spade and scoop or ring sampler methods will be used to collect samples in the drainages. Analytical samples taken as part of the Central Firing Site Aggregate will be analyzed for HE, radionuclides, and metals.

5.4.6.3 Laboratory Analysis

Fixed Base Laboratory. Fixed base laboratory analyses for radionuclides, HE, and metals will be based upon the following methods: LANL or DOE methods for alpha, beta, and gamma spectrometry, SW-846 Method 6010 for metals, and SW-846 Method 8270 for semivolatiles, and

SW-846 Method 8330 for HE and HE degradation products. The principal radionuclide of concern is uranium 235. The metals of concern are; beryllium, lead, and uranium.

5.4.6.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the latest revision of the IWP (LANL 1993, 1017). Any quality assurance/quality control (QA/QC) duplicate samples planned to be collected during the course of the field investigation are outlined in Table 5-12.

Table 5-12
Sample Analysis for Aggregate 4

PRS	Prs Type	Phase 1 Approach	Sample Media	Samples	Duplicates	Field Survey: Land Survey	Field Survey: Geophysics	Field Survey: High Explosives	Field Survey: Polynuclear Aromatic Hydrocarbons	Field Survey: Radiation	Field Screening: Gross Beta/Gamma	Field Screening: High Explosives	Field Screening: Organic Vapor	Laboratory Analyses: Gamma Spectroscopy	Laboratory Analyses: High Explosives	Laboratory Analyses: Isotopic Uranium	Laboratory Analyses: Polychlorinated Biphenyls	Laboratory Analyses: Metals	Laboratory Analyses: Semivolatiles
14-001(a-3)	Pullboxes	Screening Assessment	Soil beneath boxe	5	1					X		x		x	x		X	X	
	Aggregate Screening	Screening Assessment	Soil	12	1	X		X			X	X		X	X	X		X	
C-14-003	Explosives Prep.Bld.	Screening Assessment	Soil in building	2						X	X	X		X	X	X		X	
C-14-004	Electronics Shop	Screening Assessment	Soil in building	2															X
C-14-005	Storage Building	Screening Assessment	Soil in building	2				X		X	X				X	X		X	X
C-14-006	Magazine	Screening Assessment	Soil in building	2				X			X				X			X	
C-14-007	Storage Building	Screening Assessment	Soil in building	2				X		X	X				X	X		X	X

5.4.7 SWMU Recommended for Deferred Action Under Step Three of the Four-Step Criteria

5.4.7.1 Interim Status Open Burn/Detonation Facilities, SWMU 14-005

5.4.7.1.1 Background

SWMU 14-005 is an active burn cage made of a 55-gal. drum with approximately 3 ft^3 of burn capacity set on a steel tray. It is used to burn paper and small pieces of laboratory equipment potentially contaminated with HE. This unit is located near TA-14-35 which is also an interim status open burn/detonation facility discussed in Subsection 6.2.1.

5.4.7.1.2 Recommendation

SWMU 14-005 is recommended for DA until closure because it is operated under interim status, and is inspected routinely with any release dealt with appropriately.

5.4.7.1.3 Rationale for Recommendation

The SWMU covered in this subsection is an interim status open burn/open detonation treatment unit that is included in the Laboratory's RCRA Part B Permit Application. Its future characterization and closure (scheduled for the year 2100) is covered in Subsection 9.2.1 of Chapter 9, Closure and Post-Closure Plan, in the RCRA Part B Permit Application (LANL 1988, 15-16-388).

5.4.7.2 Active firing site, SWMU 14-001(g)

5.4.7.2.1 Background

SWMU 14-001(g) is a three-sided blast shield that directs the force of detonations away from the nearby control building (TA-14-23). At the base, the shield is a 2 ft-thick by 6 ft-square concrete pad overlaid with a neoprene shock pad, a 4.5 in.-steel plate, and several inches of sand. Wastes are placed on the pad and detonated from the control building (LANL 1988,15-16388).

5.4.7.2.2 Recommendation

SWMU 14-001(g) is recommended for DA until closure because it is operated under interim status, and is inspected routinely with any release dealt with appropriately.

5.4.7.2.3 Rationale for Recommendation

The SWMU covered in this subsection is an interim status open burn/open detonation treatment unit that is included in the Laboratory's RCRA Part B Permit Application. Its future characterization and closure (scheduled for the year 2100) is covered in Subsection 9.2.1 of Chapter 9, Closure and Post-Closure Plan, in the RCRA Part B Permit Application (LANL 1988,15-16-388).

5.5 Aggregate 5. Septic Tank at TA-14, SWMU 14-007

5.5.1 Background

TA-14-19 was built in October 1944 to serve the bathroom facilities in TA-14-6 in the central part of TA-14. In 1988, a leach field was installed, replacing a drain line from the septic tank. In the summer of 1992, when TA-14-6 was connected to the new SWSC line, the septic tank was disconnected. TA-14-6 was built as a shop, then used as a darkroom, and in 1965 was converted to use as a storage building (LANL 1993, 21-0077). The septic tank is now inactive.

5.5.2 Description and History

The septic tank, TA-14-19, was constructed of reinforced concrete and was 4 ft wide by 7 ft long by 6 ft deep, with a capacity of 640 gal. This septic tank has served the bathroom facilities in TA-14-6 since 1944. The septic tank was connected to an overflow drain line that ran out to the northeast 130 ft before daylighting into a ditch (outfall) approximately 1 ft wide. As the building was converted from a shop to a darkroom, the darkroom chemicals (including organics, silver, and cyanide) were probably disposed of into this septic tank and the drain line. A leach field was installed in 1988, and the drain line was disconnected. TA-14-6 was used for storage from 1965 to 1988 (LANL 1993, 21-0077) and only sanitary effluents were discharged into the septic tank until it was disconnected in 1992. Engineering drawings R-635 and R-636 show the relationship among the septic tank, TA-14-6, and the leach field.

5.5.3 Conceptual Exposure Model

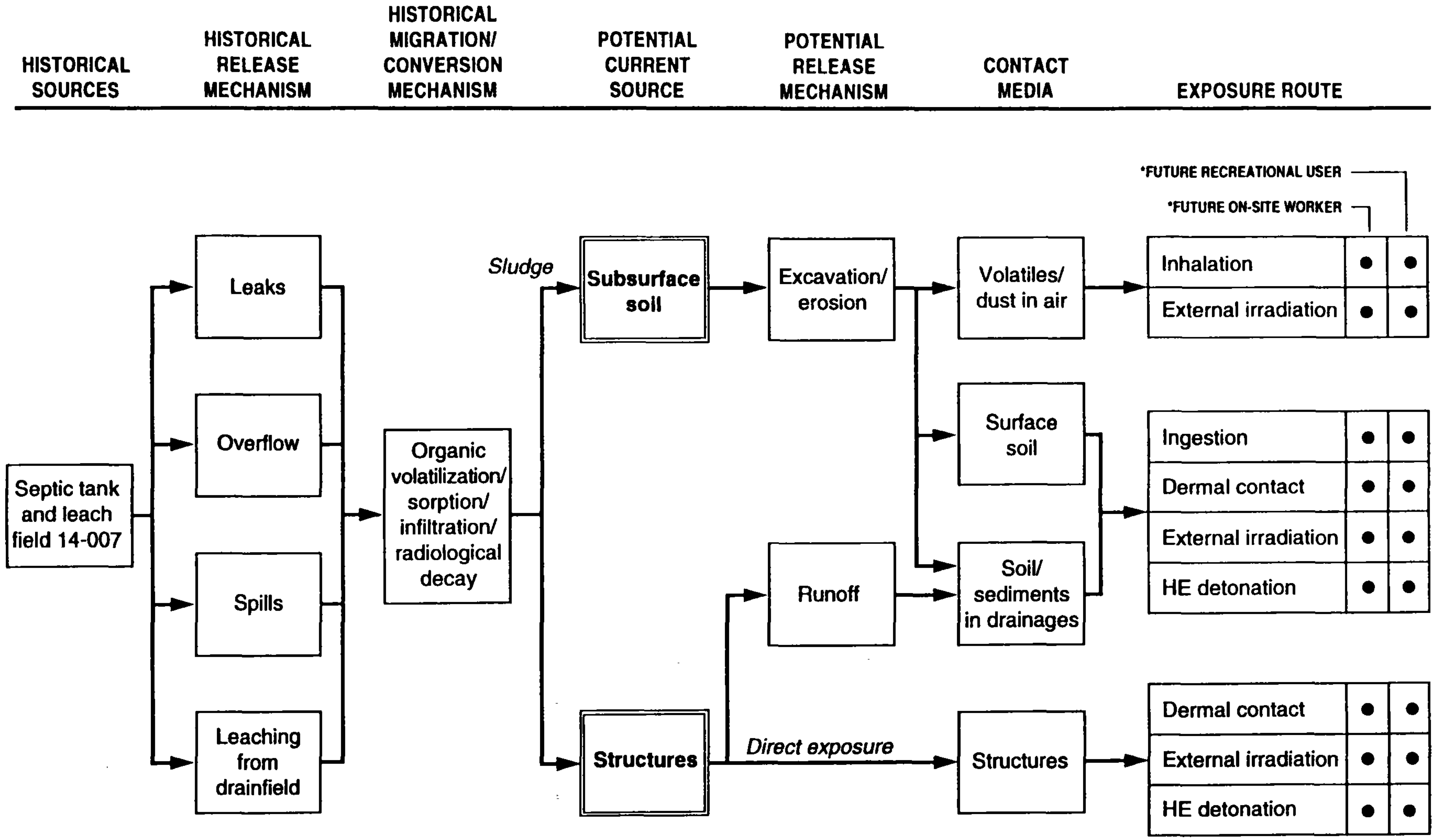
The conceptual exposure model for this aggregate is presented in Figure 5-10. Subsection 5.5.3.2 presents the potential sources of contamination and PCOCs. PRS-specific information on migration pathways and potential receptors is discussed in Subsection 5.5.3.2

5.5.3.1 Nature and Extent of Contamination

This SWMU, consisting of a septic tank and leach field, was used as the sanitary system for TA-14 and is suspected of being contaminated with photoprocessing chemicals, HE residues and degradation products, radionuclides, and metals. No quantitative information is available on the possible residual contamination as a result of the use of this SWMU as a sanitary system or darkroom.

5.5.3.2 Potential Pathways and Exposure Routes

A summary of exposure mechanisms and human receptors is presented in Table 5-13.



* No current receptors have been identified

Figure 5-10. Conceptual exposure model for Aggregate 5—TA-14: Septic Tank

TABLE 5-13

Aggregate 5, Inactive Septic Tank and Leach Field; Exposure Mechanisms and Receptors

PRS	POTENTIAL AREA OF CONTAMINATION	RELEASE MECHANISM	CURRENT POTENTIAL RECEPTORS	FUTURE POTENTIAL RECEPTORS
14-007	Subsurface soil	Excavation or erosion, resulting in wind dispersion, surface water runoff and infiltration, and external irradiation	None	Recreational users, on-site workers
14-007	Structures	Excavation or erosion exposing structures External irradiation	None	Recreational users, on-site workers
14-007	Sludge inside tanks	Leaks to surrounding subsurface soils External irradiation	None	Recreational users, on-site workers

The remaining structure is assumed to be contaminated. Leaks, overflows, and spills, as well as leaching from the drain field, could have contaminated the subsurface soil in the area. The septic system that is located in TA-14 has no public access. The constituents do not pose a current public health risk.

Since contamination is suspected only in the remaining structure and subsurface soils, there are no current human receptors.

Future human receptors could include site workers and construction workers after the area has become eroded or during excavation, or recreational users if the land reverts to the US Forest Service.

A more detailed description of the migration pathways, conversion mechanisms, potential receptors, exposure pathways, and exposure assumptions relevant to the entire OU are presented in Chapter 4.

Subsurface components of septic systems (septic tank, drain lines, and the drain field) may potentially release constituents to the surrounding soils through leaks or cracks in the pipes and structures. The highest PCOC concentrations are expected to be in the drain field and/or outfall. Surface soil may be contaminated around the outfalls from tank or drain field overflow. Once contaminants are released into the environment, they can migrate into the surrounding soils.

5.5.4 Remediation Decisions and Investigation Objectives

5.5.4.1 Problem Statement (DQO Step 1)

Historical activities at TA-14 may have resulted in release of PCOCs into the septic system. The primary problem is quantification of the concentration of PCOCs in the system. Because of the design of the septic system and the long period over which it discharged to the outfall, it is expected that the highest concentrations of PCOCs will occur in the outfall and its drainage. This septic system is not currently active. The soil in the septic tank, the drain field, and the ditch outfall will all be sampled.

5.5.4.2 Decision Process (DQO Step 2)

The Phase I environmental data will lead us to one of four actions:

1. Propose NFA for the septic system,
2. Conduct a baseline risk assessment,
3. Perform a VCA, or

4. Collect additional data in a Phase II environmental survey to better quantify the risk or understand the cost consequences of a VCA.

Data that represent the septic tank, drain field, and ditch outfall will be the primary determinant for selecting an action. The SAL will be used as a trigger value for the NFA option.

5.5.5 Data Needs and Data Quality Objectives

5.5.5.1 Decision Inputs (DQO Step 3)

Data on PCOCs for the soils and tuff associated with the septic tank drain field and ditch outfall are needed to evaluate whether concentrations differ from background or are above SALs. Concentrations of potential contaminants will be measured by a method in which the detection limit is less than the SAL. PCOCs for this aggregate are metals, silver, volatiles, semivolatiles, and cyanide.

5.5.5.2 Investigation Boundary (DQO Step 4)

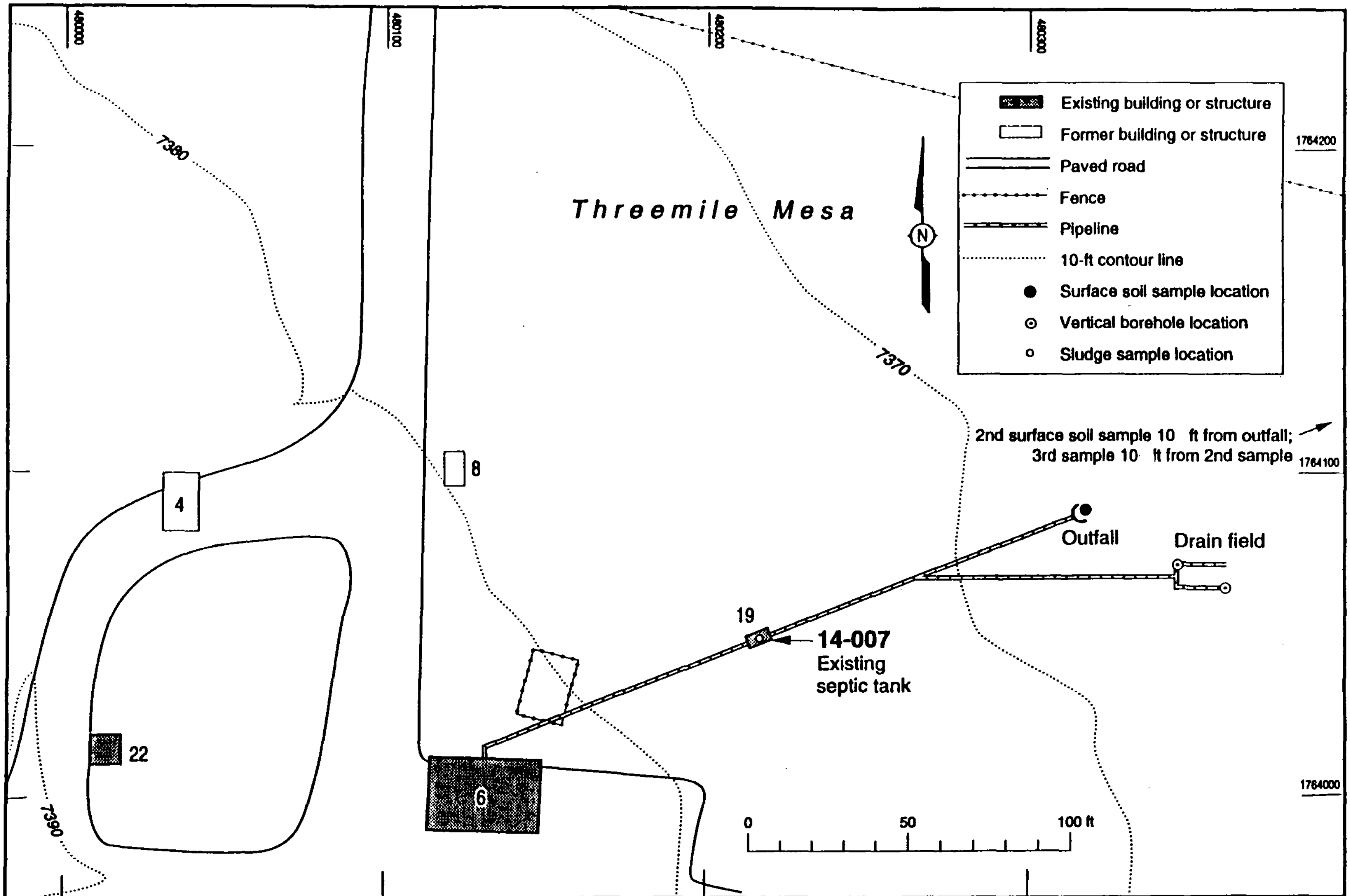
Samples will be taken to represent the tank, drain field, and the outfall.

5.5.5.3 Decision Logic (DQO Step 5)

If the concentrations are less than the SALs, then NFA will be proposed. If concentrations are greater than the SAL, then a baseline risk assessment will be conducted. If Phase I sampling detects concentrations above the SAL, then either additional Phase II samples will be collected at the tank to evaluate the extent of the contamination or a VCA will be proposed prior to D&D.

5.5.5.4 Design Criteria (DQO Step 6)

The proposed septic system sampling plan is designed to detect potential contaminants in the three most likely areas: the septic tank, the drain field, and the outfall (Figure 5-11). Because there are no existing data for this system, the data collected for the tank, drain field, and outfall will be by screening assessment sampling. Screening assessment sampling relies on its being able to bias the samples sent for full laboratory analysis by field surveys, the mobile laboratory, or a physical understanding of the distribution of PCOCs. Field surveys will bias sample collection for laboratory analysis. If field surveys yields no positives, then the soil-bedrock interface will be used to represent PCOC concentration in the soil core.



Sources: FIMAD 1993 G100991; LANL 1988, ENG-C45511
Modified by: cARTography by A. Kron 5/18/94

Figure 5-11. Sampling locations in Aggregate 5—TA-14: Septic Tank.

PCOCs released through the drain field outfall sampling are not expected to travel far from the end of the pipe. Little flow went through these lines to the outfall, and there are no other drivers for contaminant movement (the outfall is not in a storm water runoff drainage).

5.5.6 Sampling and Analysis Plan

Phase I sampling will focus on determining the presence or absence of PCOCs above SALs. A Phase II sampling plan, if necessary, will further define the nature, extent, and rate of migration of any release identified in Phase I. Refer to Appendix C, Field and Laboratory Investigation Methods, for additional OU 1085 field sampling information, including SOPs used in this sampling plan.

Field Screening. All samples will be field-screened for gross alpha, beta, and gamma to detect the presence of radionuclides. The HE spot test will be used to detect the presence of HEs. A Photoionization detector (PID) field technique will be used to detect the presence of volatiles. Those persons conducting the field screening activities will use the methods found in Laboratory SOPs, which are in preparation.

Appropriate health and safety precautions will be undertaken according to the Laboratory's ER Program SOPs (LANL 1993, 0875).

5.5.6.1 Engineering Surveys

Engineering surveys will locate, stake, and document PRS boundaries, the areas for radiation screening, HEs screening, surface and subsurface sampling, and all surface engineering and geomorphological features. All sample locations will be registered on a base map, scale 1:1200. If during the course of sampling any sample points must be relocated, the new position will be resurveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional surveyor under the supervision of the field team leader.

5.5.6.2 Sampling Rationale

This septic system discharged effluent through a concrete septic tank and then to a two branch drain field as well as an outfall. The locations most likely to harbor PCOCs are assumed to be the septic tank the proximal and distal ends of the drain field, and the outfall. Drain fields are designed to disperse effluent both laterally in and around the drain field as well as vertically down toward the fill-bedrock interface. Outfalls function as discharge pipes on the surface that allow the free flow of effluent into a drainage. Therefore, sampling will focus on

- Sludge in the septic tank, and

- Surface soil samples at and down slope of the outfall.
- Surface and borehole samples in the drainfield

5.5.6.3 Sampling Summary

SWMU 14-007, Inactive Septic System. The sample locations discussed below are shown on Figure 5-11.

Septic Tank. A sludge sample will be collected from the interior of the septic tank at SWMU 14-007.

Outfall. Three surface soil samples (0 to 6 in.) will be collected at the outfall; the first immediately below the outfall; the second and third samples will be taken at a distance of 10 and 20 ft down the drainage from the outfall.

Drainfield. Borehole locations and samples in the drainfield will be determined by HE and radiation surveys. Depth of the boreholes will be five ft. or to the soil-tuff interface, whichever is reached first.

Each soil sample will be field-screened for HEs, radioactivity, and volatiles. The screening will be performed to guide the selection of samples that will be submitted for laboratory analysis.

The PCOCs at SWMU 14-007 are HE, silver, volatile organics, HEs , radionuclides, and metals.

5.5.6.4 Fixed Base Laboratory Analysis

Fixed base laboratory analyses for radionuclides, HEs, and metals will be based upon the following methods: LANL or DOE methods for alpha, beta, and gamma spectrometry, SW-846 method 6010 for metals, SW-846 method 8270 for semivolatiles, and SW-846 method 8330 for HE and HE degradation products. The principal radionuclide of concern is uranium-235; the principal SVOCs of concern are HEs and HE byproducts and detonation products. The metals of concern are antimony, barium, beryllium, cadmium, chromium, copper, lead, and silver uranium.

5.5.6.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the latest revision of the IWP (LANL 1993, 1017). Any QA/QC duplicate samples planned to be collected during the course of the field investigation are outlined in Table 5-14.

Table 5-14
Sample Analysis for Aggregate 5

						Field Survey					Field Screening			Laboratory Analyses					
PRS	Prs Type	Phase 1 Approach	Sample Media	Samples	Duplicates	Land Survey	Geophysics	High Explosives	Polynuclear Aromatic Hydrocarbons	Radiation	Gross Beta/Gamma	High Explosives	Organic Vapor	Gamma Spectroscopy	Cyanide	High Explosives	Isotopic Uranium	Metals	Semivolatiles
14-007	Septic Tank	Screening Assessment	Sludge	1	1	X					X	X	X	X	X	X		X	X
14-007	Septic Outfall	Screening Assessment	Soil	3		X		X		X	X			X	X	X		X	X
14-007	Septic Drainfield	Screening Assessment	Soil	2		X	X	X		X	X		X	X	X	X		X	X

5.6 Aggregate 6. East Site and West Magazine: SWMUs 14-002(c), 14-002(d), 14-002(e), and 14-003; and AOCs C-14-001 and C-14-009

5.6.1 Background

The overall location of Aggregate 6 is shown in Figure 1-4 while the locations of the PRSs within the aggregate are shown in Figure 1-6.

Included in this aggregate are one unused building, two inactive firing pads, two magazines, and a trash burning area. The building (TA-14-5) has been used as a control room, a storage area, and a laboratory. The firing pads were used for the performance testing of explosives (Harris 1993, 21-0084).

In the 1950s, a trash-burning area was located to the east of TA-14-23, near the eastern site boundary, as shown on Engineering drawing R-129. The site still has a plainly visible semicircular earthen berm structure. The trash is believed to have consisted of HE-contaminated items. Residuals from trash burning may have included barium, lead, uranium, and other contaminants (Martell 1993, 21-0073).

The two magazines in this aggregate were built in late 1944 and early 1945. They were small structures of wooden construction with a soil berm on three sides and top (LANL 1993, 21-0077). Explosives used at nearby firing sites were stored in these magazines. Those unrelated SWMUs are included in one aggregate because they are all decommissioned and have similar DQOs. In addition, all have the same possible contaminants, i.e., HEs.

5.6.2 Description and History

Three of the SWMUs in this aggregate are located on the eastern part of TA-14 on a flat circular area about 100 ft in diameter. In 1944, TA-14-5 (Q-5) was constructed as a control building for an X Division firing site (Figure 5-6-1). Group X-1D, the Rotating Prism Camera Group, was the principal group operating at TA-14-5 (Bradbury, 1945, 21-0041). This group, using photographic methods such as the rotating pyramid camera and rotating mirror camera, performed detonation tests on small HE cylinders and spheres. These methods provided shadow photography of imploding explosives during detonation of different HE formulations or lens types (Hawkins 1983, 21-0090). Successive images of a blast on the same negative by using a series of HE flashes. This work was designed to understand the formation of HE jets. Relatively small tests (up to 15 lb) were conducted here because the firing pads were so close (20 to 30 ft) to TA-14-5, which is made of wood. Many shots contained uranium (Martell 1993, 21-0085).

Group X-1D was renamed Group X-8, Detonation Wave Research, in August 1945, and GMX-8, Explosives Phenomena Group, in 1948 (Martell 1993, 21-0085). In 1949, GMX-8 fired a beryllium block at TA-14-5 (21-0042). Small-scale firing occurred during the postwar years.

TA-14-5 has its entrance on the north side, and the two firing pads are on the south side. The firing pads are on a flat area about 100 ft wide that appears to have been built up by hauling in soil to form a knoll. The ground then slopes from the knoll to three sides (east, west, and south) into a drainage to the south that runs west to east. The knoll, which is the working area, is graveled and surrounded by grass and ponderosa pines. TA-14-5 is bermed with soil to the top of the building on the east and west sides. Three large (one is 15 ft long x 9 ft wide x 5 ft high, two are 6 ft long x 8 ft wide x 5 ft high) concrete blocks were positioned on the south side of the building. These blocks of concrete were removed from the building in the mid-1950s and are now located off the knoll about 50 ft south in the drainage that runs east and west (Martell 1993, 21-0085).

SWMUs resulting from these activities are presented in Table 5-15.

SWMU 14-002(c) (TA-14-5) was built in 1944 as a control building. It is 11 ft long x 18 ft wide x 10 ft high and originally had a concrete bunker faced with 0.5 in. steel plate. It was converted from a control building to a storage site in 1961, to toxic gas (cyanogen) storage in 1965. In 1965, the cyanogen gas was once used to fabricate explosives and, when the gas was no longer needed, workers destroyed it by placing the cylinders on a firing pad, surrounding them with explosives and detonating them (Martell 1993, 21-0085) and to a large-scale thermal test laboratory in 1980. After TA-14-5 was converted to a storage building in 1961, no further explosive experiments were conducted at the firing pad (Harris 1993, 21-0084).

In the mid-1950s, the concrete blocks were removed from the south end of the building and pushed about 50 ft south to the side of the small drainage that drops to the south. Debris is scattered about on this slope to the drainage channel. In 1980, a 5 ft diameter metal sphere was placed on the south side of TA-14-5 in the position previously occupied by the concrete blocks. Slow combustion experiments were conducted inside the sphere (Martell 1993, 21-0085). These tests continued until 1985. TA-14-5 has not been used since then and was to be destroyed but the destruction was delayed while a discussion was held about putting the building on the Laboratory's historical buildings list. It was decided not to list TA-14-5 but, by that time, funds for the destruction were not available and it still stands (Harris 1993, 21-0084).

SWMU 14-002(d) and SWMU 14-002(e). These two firing pads are located 35 ft apart on the south end of TA-14-5, which served as their control building. Performance tests of explosives were conducted on these two firing pads. The shots were photographed through two ports in

Table 5-15

PRSs in the East Site and West Magazine

PRS	STRUCTURE NUMBER	DESCRIPTION
14-002(c)	TA-14-5	Firing site (decommissioned)
14-002(d)		Firing site (decommissioned)
14-002(e)		Firing site (decommissioned)
14-003		Trash burning area
C-14-001	TA-14-1	Magazine (decommissioned)
C-14-009	TA-14-13	Magazine (decommissioned)

which 5-in.-diameter glass disks were placed and discarded after each shot. These glass disks (both whole and broken) are part of the debris that is scattered on the south slope. Because these two pads are only 35 ft apart, contaminants from the two SWMUs are considered together.

C-14-001 (TA-14-1) This former magazine is located in a wooded area 300 ft west of the western complex at TA-14. TA-14-1 was of wooden construction 9 ft wide by 11 ft long by 8 ft high with a soil berm on three sides and the top. It lies on a level mesa 50 ft north of the rim of Cañon de Valle. The terrain slopes south to a row of low cliffs. To the west is a small canyon draining south. C-14-001 is about 25 ft in diameter and is located in the center of a 75-ft-diameter clearing on the forested mesa.

TA-14-1 was served by an asphalt road, now abandoned, that joined R-Site Road on the north and circled the structure. The TA-14-1 berm remains as a pile of soil and tuff with a light growth of small shrubs; there is no sign of debris remaining from the structure itself on the old road circling the berm. Piles of asphalt chunks and gravel are stored. The road and piles act as effective barriers to stop any drainage from the berm. TA-14-1 was built in October 1944 and was deliberately burned and destroyed in February 1963 (LANL 1993, 21-0077). TA-14-1 was reported to be contaminated with HE in 1959 (CEARP ID No. TA14-1CA-A/I-HW/RW in DOE 1987, 0264).

C-14-009 (TA-14-13) This former magazine is located at the eastern end of TA-14, about 50 ft northeast of bunker TA-14-5. It was of wooden construction 3 ft wide x 4 ft long x 3 ft high with a soil berm on three sides and the top. C-14-009 lies on a low knoll at the head of a small drainage that drops to the southeast. The area is at the edge of a pine forest. A berm 6 ft in diameter remains at the site, as do traces of an unimproved road that once allowed access to the magazine from the west. Both are covered with grasses and weeds. The remains of a boardwalk running east to the former TA-14-13 from TA-14-5 are still visible. This evidence, particularly the berm, mark the location of the magazine quite accurately. This magazine was built in January 1945 and was destroyed by burning in February 1960 (LANL 1993, 21-0077). The magazine was reported contaminated with HE in 1959 (CEARP ID No. TA14-1CA-A/I-HW/RW in DOE 1987, 0264).

SWMU 14-003 The burn area is 300 ft northeast of TA-14-5. The burn pit is bermed, with a 4-ft-high horseshoe of dirt with the open end facing east. Grasses and weeds have grown on the berm and have stabilized it. A paved road that leads to the bermed area from TA-14-6 is clearly visible. The area is level with no drainage paths. High-explosive-contaminated combustible, and frequently noncombustible, material was disposed of in this burning area as evident by several charred but unburned items that are still visible (Martell, 1993, 21-0073).

5.6.3 Conceptual Exposure Model

5.6.3.1 Nature and Extent of Contamination

The former control building [TA-14-5, SWMU 14-002(c)] was used in firing experiments and is suspected of being contaminated with HE residues and degradation products, metals, and radionuclides. It was also used as a toxic gas storage area and a large-scale thermal testing laboratory. No quantitative information is available on the possible residual contamination as a result of these activities.

Two other PRSs [SWMU 14-002(d) and SWMU 14-002(e)] are the firing pads associated with the control building. Because the control building was converted to other uses in 1961, the pads have not been used for their original purpose for over 30 years. They are suspected of being contaminated with HE residues and degradation products, metals, and radionuclides. As in the case of the control building, no quantitative data are available on the contamination present as a result of these activities.

Another site (SWMU 14-003) was used for burning HE-contaminated items, and a certain amount of debris is still present. It is suspected of being contaminated with HE residues and degradation products, radionuclides, and metals.

Two former magazines (C-14-001 and C-14-009) were used to store HEs used in firing experiments and are suspected of being contaminated with HE residues and degradation products. No quantitative information is available on the possible residual contamination as a result of these activities.

5.6.3.2 Potential Pathways and Exposure Routes

The conceptual exposure model is presented in Figure 5-12. A summary of exposure mechanisms and human receptors is presented in Table 5-16.

Contamination from the inside of the control building could have leaked or spilled to the outside during its operation. There are no known sumps associated with this building. However, there is one drainage (possibly storm).

Surface soils around the firing sites may have been contaminated due to dispersion of explosives, radionuclides, and metals during detonations. Wind dispersion of the contaminants on the surface may have occurred. No low-order detonations are known to have occurred at TA-14-5.

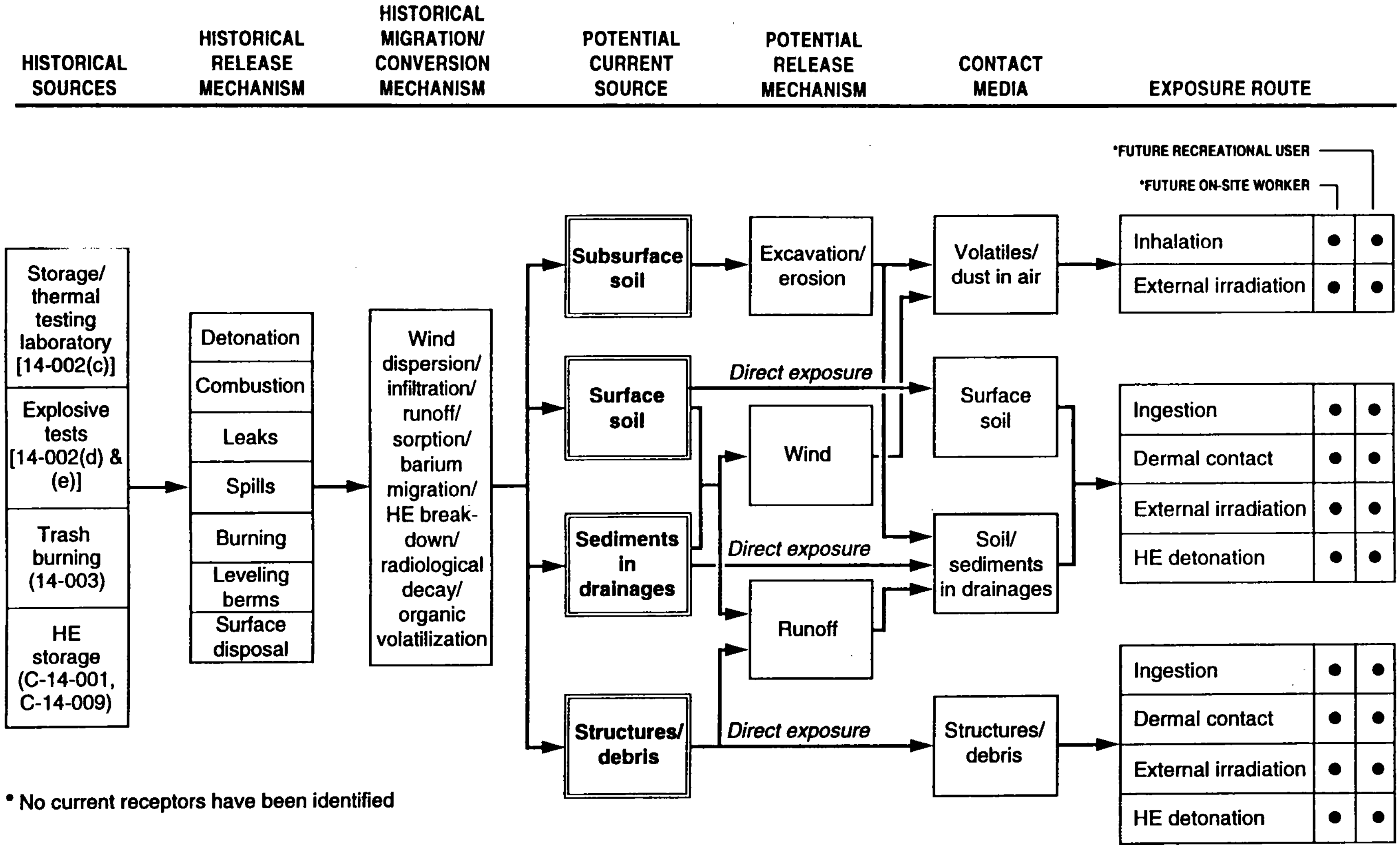


Figure 5-12. Conceptual exposure model for Aggregate 6—TA-14: East Site and West Magazine.

TABLE 5-16

Aggregate 6 East Site & West Magazine Exposure Mechanisms and Receptors

PRS	POTENTIAL AREA OF CONTAMINATION	RELEASE MECHANISM	CURRENT POTENTIAL RECEPTORS	FUTURE POTENTIAL RECEPTORS
14-002(c)	Building TA-14-5	External irradiation	On-site workers	Recreational users, on-site workers
14-002(d), 14-002(e), 14-003, C-14-001, C-14-009	Surface soil around firing pads, surface soil in burn area, and sediments in drainages	Wind dispersion Surface water runoff/ infiltration External irradiation	On-site workers	Recreational users, on-site workers
14-003	Debris	External irradiation	On-site workers	Recreational users, on-site workers

The mesa in the east area slopes to the south where a drainage channel is evident; therefore, surface water run-off is considered to be a major pathway.

Leaks or spills could have occurred in or near the decommissioned magazines (C-14-001 and C-14-009). In addition, contamination may have been dispersed when the berm was leveled. For C-14-001, there is a visible drainage channel that provides a surface water runoff pathway. Infiltration of surface water could also have transported contaminants into the sediments and soil in the drainage, as well as into the soil beneath the footprints of the former structures. Wind dispersion of surface contaminants may also have occurred.

The terrain in the vicinity of the trash-burning area (SWMU 14-003) gently slopes to the east, and there are no drainage channels evident. Infiltration of surface water could have transported contaminants into the soil in the bermed area. Wind dispersion of the contaminants on the surface may have also occurred.

A more detailed description of the migration pathways, conversion mechanisms, potential receptors, exposure pathways, and exposure assumptions relevant to the entire OU are presented in Chapter 4.

5.6.4 Remediation Decisions and Investigation Objectives

5.6.4.1 Problem Statement (DQO Step 1)

The Phase I problem is to determine whether contaminants are at levels of concern in any PRS in this aggregate. This aggregate consists of decommissioned firing sites, a trash-burning area, and two decommissioned magazines. There is potential for near-surface contamination (upper 6 in. of soil) at most PRSs in this aggregate. The firing sites may have dispersed metal, radionuclide, and HE contamination over a large area. It is possible that metals and polycyclic aromatic hydrocarbons (PAHs) are residual from burning operations. Probability of contamination is moderate at the firing sites and burning pit, and low at the decommissioned magazines.

5.6.4.2 Decision Process (DQO Step 2)

The objective of the Phase I investigation for this aggregate will be screening assessment sampling to determine if PCOC concentrations are above action limits in surface soils. If PCOC concentrations in a PRS are below SALs, then NFA will be proposed for that PRS. If PCOC concentrations are greater than SALs, then a Phase II study will be performed to determine the spatial extent and concentration of the contaminant relative to an acceptable risk level.

The potential remediation options for PRSs that pose an unacceptable health and environmental risk include removal of the contaminated surface and/or subsurface soils with treatment and/or disposal. The need for remedial action will be supported by data on contaminant levels gathered in a Phase II sampling plan.

5.6.5 Data Needs and Data Quality Objectives

5.6.5.1 Decision Inputs (DQO Step 3)

Data are needed primarily to confirm suspected PCOCs, to identify additional PCOCs, and to determine concentrations of all PCOCs in surface soils. These PRS areas are to be located for efficient sampling, site information on facilities from visual indications, engineering drawings, and aerial photographs are needed.

5.6.5.2 Investigation Boundaries (DQO Step 4)

The spatial boundaries of potential contamination for the PRSs include the PRS boundaries for the decommissioned structures and the burn site. The firing site will be examined to a radius of 75 ft because of the small size of the shots at the site. Although the original location of the PCOCs at the magazine footprints was the soil surface (less than 6 in.), the decommissioning activities probably redistributed or covered the PCOCs. Given the shallow soil at Q-Site, the depth boundaries for surface soil will be the top 12 in. of soil or the depth to tuff, whichever is less. The depth boundary for the burning area will also be 12 in., because the PCOCs would be expected to be relatively immobile.

For each PRS, sampling points will be biased to areas believed most likely to contain the highest concentrations of PCOCs, based on field surveys, archival data, and the results of land surveys.

5.6.5.3 Decision Logic (DQO Step 5)

Screening assessment decision rules are stated for each PRS or aggregate (off-site migration) in terms of the maximum observed concentration of each PCOC. If the maximum observed PCOC concentrations in surface or subsurface soils for a PRS are above their SALs and above any constituent background level, then a Phase II study will be performed. If SALs or background levels are not exceeded, then NFA will be proposed for the PRS. Some adjustments are made to this decision rule to account for PCOCs for which SALs are less than the normal range of background (e.g., beryllium), or if several PCOCs exhibit concentrations that are close to SALs without actually exceeding them. Chapter 4 Subsection 4.1.4 and Appendix J of the IWP (LANL 1993, 1017) provide details of the effect of these adjustments on the decision rule.

5.6.5.4 Design Criteria (DQO Step 6)

5.6.5.4.1 SWMUs 14-002(d) and 14-002(e) Firing Pads Sampling Grid

Samples will be biased by field surveys for HEs and radionuclides and the field laboratory for semivolatile HE by-products and metals as appropriate. Six laboratory surface sampling points for the firing site, obtained by the nomogram approach, provide an 80% chance of detecting contamination if 25% of the site is contaminated (see Chapter 4).

The radius size was decided after a visual survey found no shot debris at a greater radius. If the soil samples prove to be highly contaminated, a Phase II investigation can include samples at a greater radius.

5.6.5.4.2 PRSs 14-002(c,d,e), 14-003, C-14-001, and C-14-009

A reconnaissance approach will be used to sample these six PRSs (Chapter 4). Because of the small size of each PRS and the nature of the processes that may have produced contamination within them, it is likely that a high percentage of each PRS is contaminated, if any contamination exists. Because of this likely homogeneous distribution of potential contamination, the nomogram approach suggests that two samples for each PRS would provide a 75% detection probability if 50% of each PRS was contaminated.

5.6.6 Phase I Sampling and Analysis Plan

Phase I sampling will focus on determining the presence or absence of PCOCs above SALs. A Phase II sampling plan, if necessary, will further define the nature, extent, and rate of migration of any release identified in Phase I. Refer to Appendix C, Field and Laboratory Investigation Methods, for more information.

Field Screening. All samples will be field-screened for gross alpha, beta, and gamma to detect the presence of radionuclides. In addition, all will be swiped for the HE spot test to detect the presence of HEs.

Appropriate health and safety precautions will be undertaken according to the Laboratory's ER Program SOPs (LANL 1993, 0875).

5.6.6.1 Engineering Surveys

Engineering will survey, locate, stake, and document PRS boundaries, the areas for HE and radiation surveys, HE screening, surface sampling, and all surface engineering and geomorphological features. All sample locations will be registered on a base map, scale 1:1200. If during the course of sampling any sample points must be relocated, the new position will be surveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

5.6.6.2 Sampling

5.6.6.2.1 Sampling Rationale

The structures in this aggregate were used for the storage of explosives or for firing site structures until the time they were removed or decommissioned. The trash-burning area was a bermed area used to dispose of refuse from TA-14 operations. The history of the five former structures and the trash burning area suggest that HEs, metal, and radionuclide contamination may be present.

The activities documented to have taken place in TA-14-5 suggest that the interior of the building has the potential for heavy contamination with HEs or HE by-products. Sampling of TA-14-5 must determine the presence of PCOCs inside the building as well as outside. Samples within the interior of the building will be made up from the collection of residual soil and/or debris or from small plugs into the structure. Samples on the exterior of the building will be surface soil samples from 0 to 6 in.

The history of the two firing pads also suggests that HEs as well as radionuclides and metals are possible contaminants.

The magazines (PRSs C-14-009 and C-14-001) were used for the storage of explosives up until the time they were decommissioned and burned. The soil berms that originally surrounded three sides of the magazines still exists. The history of the magazines suggest that HEs and metal (lead, barium) contamination are possible. The trash-burning area was similarly bermed and calls for a similar sampling rationale.

The need to detect any migration of PCOCs down drainage channels and off the East Site will be fulfilled by the collection of four surface soil samples (0 to 6 in.) in the drainage to the south of TA-14-5.

5.6.6.2.2 Sampling Techniques

Those samples collected with a hand-auger and thin-walled tube sampler will be advanced to a depth of 6 in. The 6-in. depth is designed to ensure the detection of PCOCs that may have migrated below the immediate surface through weathering processes or mechanical disturbance over the past 50 years. Sampling specified to collect surface soil will be gathered with either the spade and scoop or ring sampler technique to a depth of 1 in. The specific technique will be determined by the field team leader.

See Figure 5-13 for planned sample locations, and Table 5-16 for a listing of planned sampling.

5.6.6.2.3 Sampling Summaries

All samples will be surveyed for HE and radiation to bias samples.

SWMU 14-002(c), Bunker TA-14-5. The interior of this bunker will be screened for radionuclides, HEs, and metals. The location of the highest readings will be sampled.

Surface soil samples, 0 to 6 in., will be screened at the exterior walls of the bunker on the west, east, and north sides. Two laboratory samples will be selected based on the biasing scheme described above.

SWMUs 14-002(d) and 14-002(e), Firing Pads. Sampling at these SWMUs will consist of the collection of two hand-auger samples to a depth of 6 in. at each SWMU. Each sample location will yield one analytical sample, 0 to 6 in. The physical location of the four hand-augered samples will be

- 5 ft from the southwest corner of the bunker,
- 5 ft from the southeast corner of the bunker,
- on the south edge of SWMU 14-002(d), and
- on the south edge of SWMU 14 002(e).

SWMU 14-003, Trash Burning Area. The hand auger thin-walled sample method will be used to collect two samples to a depth of 12 in. in the approximate center of the former structure. A second hand auger sample will be located 3 ft from the first sample to the east.

C-14-001, Former Magazine TA 14-1. The hand auger thin-walled sample method will be used to collect one sample to a depth of 12 in. in the approximate center of the former structure. A second hand augered sample will be located 5 ft downslope from the first sample (south).

C-14-009, Former Magazine TA-14-13. Sampling at this AOC will consist of the collection of two hand-auger samples to a depth of 12 in. Each sample location will yield one analytical sample. The physical location of the two hand augered samples will be (1) approximate center of the former magazine and (2) 5 ft downslope (southeast) from the center of the magazine.

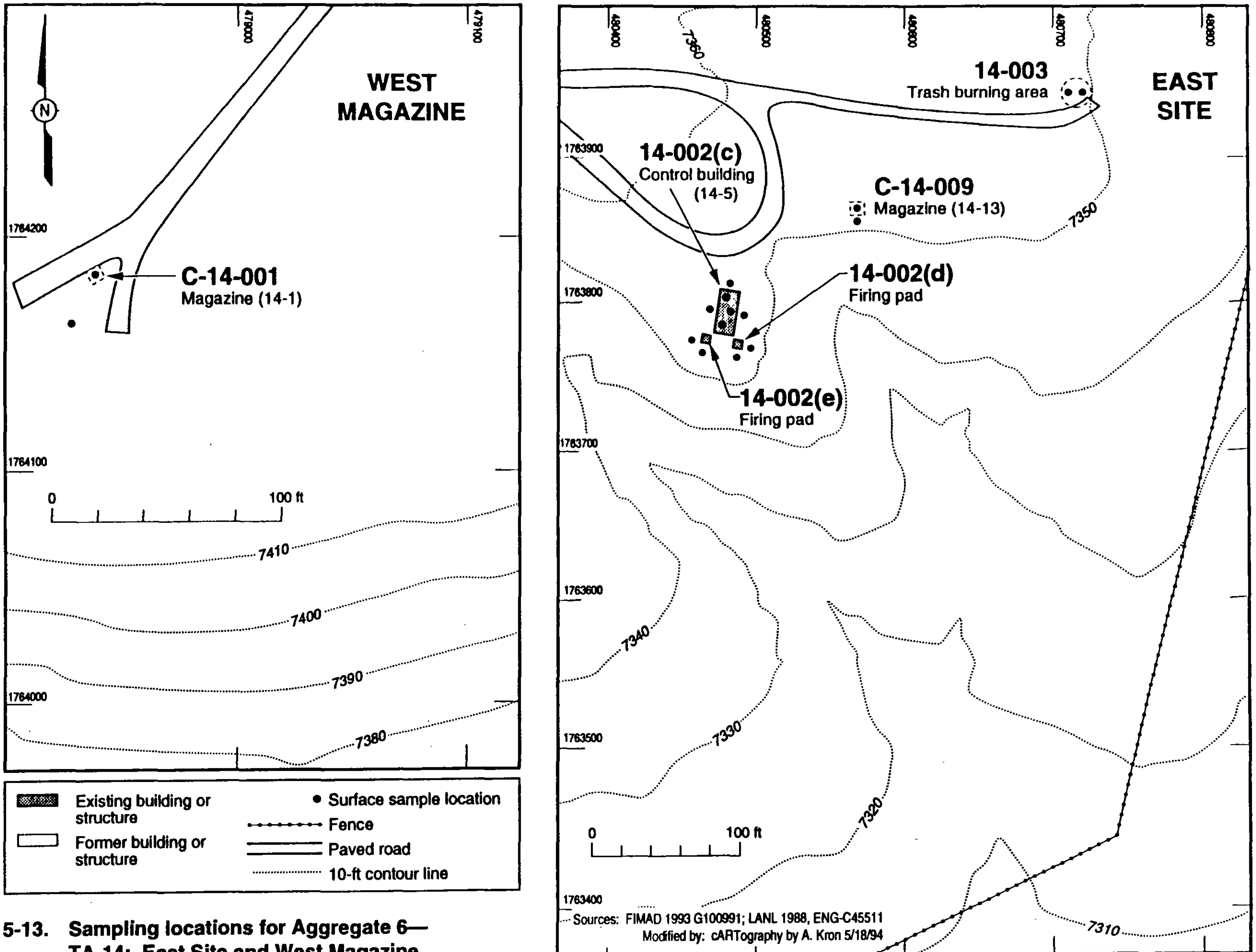


Figure 5-13. Sampling locations for Aggregate 6—TA-14: East Site and West Magazine.

Table 5-17
Sample Analysis for Aggregate 6

						Field Survey					Field Screening			Laboratory Analyses				
PRS	Prs Type	Phase 1 Approach	Sample Media	Samples	Duplicates	Land Survey	Geophysics	High Explosives	Polynuclear Aromatic Hydrocarbons	Radiation	Gross Beta/Gamma	High Explosives	Organic Vapor	Gamma Spectroscopy	High Explosives	Isotopic Uranium	Metals	Semivolatiles
14-002(c)	Control Building	Screening Assessment	Soil in building	1				X		X	x			x	x	X	x	
14-002(c)	Control Building	Screening Assessment	Soil outside building	3		X		X		X	x			x	x	X	x	
12-002(d, e)	Firing pads	Screening Assessment	Soil in building	4	1	X		X		X	X			X	X	X	X	
14-003	Trash burning area	Screening Assessment	Soil	2		X		X		X	X		X	X	X	X	X	X
C-14-001	Magazine	Screening Assessment	Soil	2	1	X		X		X	X				X		X	
C-14-009	Magazine	Screening Assessment	Soil	2		X		X		X	X				X		X	
Aggregate 6	Offsite Migration	Screening Assessment	Soil	4		X		X		X	X			X	X	X	X	

East Site Drainage Sampling. Four surface soil samples will be collected to ensure that PCOCs have not migrated down the drainage on the southeastern side of TA-14. These samples will verify that PCOCs are not leaving the TA-14 site. The spade and scoop or ring sampler methods will be used to collect samples in the drainage.

5.6.6.3 Mobile Analytic Mobile Laboratory Analysis

The results of field screening will determine whether samples will be analyzed in the mobile analytical laboratory. Gross alpha/beta spectrometry will be used to verify the presence of uranium-235 radionuclides, gross gamma spectrometry will be used verify the presence of uranium-238. The presence of HE degradation products will be verified in the mobile laboratory by the use of gas chromatography/mass spectroscopy (GC/MS) and/or flame ionization detector (FID).

Fixed base laboratory analyses for radionuclides, HEs, and metals will be based upon the following methods: LANL or DOE methods for alpha, beta, and gamma spectrometry, SW-846 method 6010 for metals, SW-846 method 8270 for semivolatiles, and SW-846 method 8330 for HE and HE degradation products. The principal radionuclide of concern is uranium-235; the principal semivolatile organic compounds (SVOCs) of concern are HEs and HE by-products and detonation products. The metals of concern are antimony, barium, beryllium, cadmium, chromium, copper, lead, and uranium.

5.6.6.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the latest revision of the IWP (LANL 1993, 1017). Any quality assurance/quality control (QA/QC) duplicate samples planned to be collected during the field investigation are outlined in Table 5-16.

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CHAPTER 6

PRSs RECOMMENDED FOR NFA

6.0 POTENTIAL RELEASE SITES RECOMMENDED FOR NO CURRENT RCRA FACILITY INVESTIGATION WITHOUT FURTHER CHARACTERIZATION

The purpose of this chapter is to identify those potential release sites (PRSs) that do not require a current RFI. All PRSs covered in this chapter are recommended for NFA. The locations of these PRSs are shown in Figures 1-3 through 1-6. To this end, a four-step evaluation criteria for NFA following archival investigation was developed and is described in Subsection 4.1 of Appendix I in the 1993 WP (LANL 1992, 1017).

The OU 1085 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. 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 is an approved accumulation area currently regulated under 40 CFR 262, Standards Applicable to Generators of Hazardous Waste. Releases will be cleaned up immediately in accordance with the Laboratory's Contingency Plan, Spill Prevention Countermeasures and Control Plan, and/or administrative requirements.

Criterion 3. The PRS will be addressed within another PRS.

A detailed description of each PRS and the rationale for the associated decision and applicable references are contained in the subsection of Chapter 6 devoted to that PRS or aggregate of PRSs. The order of presentation is HSWA Module VIII SWMUs, non-HSWA Module SWMUs and AOCs, and HSWA and non-HSWA SWMUs and AOCs that are recommended for NFA.

6.1 SWMUs Recommended for No Further Action Under Criteria 2

6.1.1 Satellite Storage Areas, SWMU 14-004(b)

6.1.1.1 Background

Satellite storage areas are approved accumulation areas that are currently regulated under 40 CFR 262, Standards Applicable to Generators of Hazardous Waste. The Laboratory conducts training classes for the operation of these areas. LANL also inspects and has institutional controls governing the closure of these units. The NMED also performs annual inspections.

6.1.1.2 Recommendation

SWMU 14-004(b) is recommended for NFA under 40 CFR 262.

6.1.1.3 Rationale for Recommendation

If a release occurred at this area, it would be cleaned up immediately in accordance with the Laboratory's Contingency Plan, Spill Prevention Countermeasures and Control Plan, and/or administrative requirements. Because any releases will be cleaned up immediately, these units do not have the potential to become historical release sites. Therefore, these areas will continue to be regulated under 3004(a) of the RCRA and not 3004(u) of the Hazardous and Solid Waste Amendments.

6.2 PRSs Recommended for No Further Action Under Criteria 3

6.2.1 Contaminated pole, C-12-006

6.2.1.1 Background

C-12-006 is described as a tall pole with a plastic tube near TA-12-8 that became contaminated with HE and strontium-90 as a result of a release during a radiation experiment in 1950.

6.2.1.2 Recommendation

C-12-006 is an example of an error in Appendix C of the SWMU Report: C-12-006 is a duplicate reporting of one of the elements of SWMU 12-004(a). C-12-006 should be removed from Appendix C of the SWMU Report.

6.2.1.3 Rationale for Recommendation

Based on field investigation and a review of the existing documentation (SWMU Reports) (LANL 1990, 0145) this unit is a duplicate of SWMU 12-004(a) which is being recommended for sampling in Subsection 5.2 of this work plan.

6.2.2 Satellite Storage Areas, SWMUs 14-004(a,c)

6.2.2.1 Background

Satellite storage areas are units that are currently regulated under 40 CFR 262, Standards Applicable to Generators of Hazardous Waste. The Laboratory conducts training classes for the operation of these areas. It also inspects and has institutional controls governing the closure of these units. The NMED also performs annual inspections.

6.2.2.2 Recommendation

SWMUs 14-004(a,c) are recommended for NFA and delisting from the SWMU Report because they are regulated under 40 CFR 262.

6.2.2.3 Rationale for Recommendation

If a release occurred at these areas, it would be cleaned up immediately in accordance with the Laboratory's Contingency Plan, Spill Prevention Countermeasures and Control Plan, and/or administrative requirements. Because any releases will be cleaned up immediately, these units do not have the potential to become historical release sites. Therefore, these areas will continue to be regulated under 3004(a) of the RCRA and not 3004(u) of the Hazardous and Solid Waste Amendments. Any long-term preexisting releases in these SWMUs will be cleaned up as part of the VCA/CMS/CMI associated with the decommissioning of the active firing site, 14-001(g).

6.2.3 SWMUs Recommended for No Further Action Under Criteria 1

6.2.3.1 Burn Site, SWMU 12-002

6.2.3.1.1 Background

SWMU 12-002 is an area used on one occasion to burn scrap HE. It encompassed a few square feet at most and was located in the roadbed just east of TA-12-4. In October 1962, during a survey of GMX-7 property at TA-12 workers found a can containing about one-half pound of HE. The material was covered with dry excelsior, doused with kerosene, and destroyed by burning. After burning, the fire department wet down the area to prevent any fire from spreading to adjacent flammable materials (Anderson 1962, 21-0012).

6.2.3.1.2 Recommendation

SWMU 12-002 is recommended for NFA and delisting from the SWMU Report because there is no reasonable basis for characterization of the site based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (LANL 1993, 1017).

6.2.3.1.3 Rationale for Recommendation

Based on available documentation, SWMU 12-002 was the site of a onetime event and was not a waste disposal area. Since 1962 the roadbed has been regraded many times redistributing and diluting any combustion byproducts. The area immediately surrounding the area was the site of many years of uncontained explosives testing and this area will be investigated under SWMU 12-001(b) in Subsection 5.1 of this work plan. Any possible contamination arising from SWMU 12-002 will be commingled with and indistinguishable from contamination associated with SWMU 12-001(b)

6.2.3.2 Gas Cylinder Storage Area, SWMU 12-003

6.2.3.2.1 Background

SWMU 12-003 is a former gas cylinder storage area located on the south side of the unimproved road and about one mile east of the TA-12-4 firing pit. The unit is in a small clearing covered with low shrubs and there are no visual indications that any activity took place. The area was used in 1968 for laser-based mortar-point-of-launch locator experiments. An acetylene gas gun was used to propel the inert mortar rounds. In 1989 HSE-7 removed two gas cylinders from the area. The waste disposal form for this unit, dated June 15, 1989, lists oxygen and acetylene cylinders and an empty firing chamber as having been sent to gas cylinder storage (Jackson 1989, 21-0051).

6.2.3.2.2 Recommendation

SWMU 12-003 is recommended for NFA and delisting from the SWMU Report because there is no reasonable basis for characterization of the site based on considerations of human health and environmental risk, community concern, laboratory operations, and value of information (LANL 1993, 1017). There exists no documentation or physical evidence that RCRA hazardous waste was ever handled at SWMU 12-003.

6.2.3.2.3 Rationale for Recommendation

The experiments at SWMU 12-003 did not involve hazardous materials and did not generate hazardous waste. The mortar rounds used in the experiment were inert, non explosive rounds, propulsion was provided by oxygen/acetylene combustion rather than conventional gun propellant (Watanabe 1993, 21-0091). The gas cylinders were removed from the area and taken to the empty cylinder storage area. No documentation has been found that would indicate that any of the activities generated hazardous waste.

6.2.3.3 Landfill/Surface Disposal, SWMU 14-008

6.2.3.3.1 Background

SWMU 14-008 is listed as a landfill/surface disposal near TA-14 where a long-time employee recalls placing some classified material in a drainage channel and covering it. The employee does not remember the location of the burial and does not believe that the material contained hazardous waste. The information about this PRS is insufficient to design an effective sampling plan; however, sampling plans have been designed to determine if contaminants of concern are migrating away from the main firing sites at TA-14. These firing sites are described in Subsections 5.3 and 5.4 of this work plan.

6.2.3.3.2 Recommendation

SWMU 14-008 is recommended for NFA.

6.2.3.3.3 Rationale for Recommendation

The location of this PRS is totally unknown and because there is no reasonable basis for indiciation that hazardous materials were disposed at the site (LANL 1993, 1017).

Chapter 6 References

Anderson, J. C., October 26, 1962. "TSR #4: DISPOSAL OF SCRAP EXPLOSIVES AT L-SITE," Los Alamos National Laboratory Memorandum LA62001048, Los Alamos, New Mexico. (Anderson 1962, 21-0012)

Jackson, F., June 15, 1989, "LANL CHEMICAL WASTE DISPOSAL REQUEST," Los Alamos National Laboratory, Los Alamos, New Mexico. (Jackson 1989, 21-0051)

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-92-3795, Los Alamos, New Mexico. (LANL 1993, 1017).

Watanabe, S., November 23, 1993. "Interview with Brad Martin. CST-6," Los Alamos National Laboratory Memorandum to File from Steve Watanabe (E525), Los Alamos, New Mexico. (Watanabe 1993, 21-0091)

ANNEX I

PROJECT MANAGEMENT PLAN

I PROJECT MANAGEMENT PLAN

This annex presents the technical approach, organizational structure, schedule, budget, and reporting milestones for implementation of the OU 1085 RFI work plan. This plan is an extension of the ER Program Project Management Plan in Annex I of the IWP (LANL 1992, 0768). The OU 1085 RFI work plan does not contain any deviations from the IWP. This annex addresses the project management requirements of the HSWA)Module (Task II, E., p. 39) of the Laboratory's RCRA Part B Permit (EPA 1990, 0306). The facility transition (FT) and D&D programs will be integrated into this RFI characterization as these programs evolve.

I.1 Technical Approach

The technical approach employed for the OU 1085 RFI work plan is described in Chapter 4. This approach is based on the ER Program's overall technical approach to the RCRA facility investigation/corrective measures study (CMS) process described in Chapter 3 of the IWP (LANL 1992, 0768). The following key features characterize the ER Program approach:

- Use of action levels as criteria to trigger a CMS;
- Sampling approach to site characterization;
- Decision analysis and cost effectiveness to support the selection of remedial alternatives;
- Application of the observational approach to the RFI/CMS process as a general philosophical framework; and,
- Integration of CERCLA, NEPA, AEA, and other applicable regulations.

The general philosophy is to develop and iteratively define the nature and extent of contamination at OU 1085 through a planned, phased investigation and data interpretation. An objective is to support VCA or a CMS using the minimum data necessary.

The technical objectives of the phased RFI, as detailed throughout this work plan, are to:

- Identify contaminants present at each SWMU and, if none are present, proceed to NFA,
- Determine the vertical and lateral extent of the contamination at each SWMU,

- Identify contaminant migration pathways,
- Acquire sufficient information to allow quantitative migration pathway and risk assessment, as necessary,
- Provide necessary data for the assessment of potential remedial alternatives including VCAs,
- Provide the basis for planning detailed CMSs,
- Use of RCRA Subpart S regulation's conditional remedy concept to adopt an approach of stabilization in-place for material disposal areas (MDAs) as appropriate.

I.1.1 Implementation Rationale

Scheduling of investigations is based on the following rationale and priorities.

Initial efforts are focused on obtaining OU-wide environmental data that form the basis for understanding contaminant transport processes. These investigations, described in Chapter 4, include:

- Geomorphic characterization of drainage channels to determine locations for representative sampling of mobile sediments, surface geophysics measurements to locate buried pipes, and radiation surveys to define areas contaminated by radioactive elements; and,
- Measurement of contaminant levels in surface soils as a basis for determining if low levels of contaminants detected at individual SWMUs are indicative of releases from individual SWMUs or only represent the presence of the OU-wide contamination.

Generic investigations include surface sampling at individual SWMUs, channel sediment sampling, sampling at subsurface structures such as septic tanks and sumps, near-surface sampling at buried outfalls and leach fields, and sampling of landfills and berms. Sites with unique problems, such as MDAs, are addressed separately.

I.1.2 Schedule

The schedule for the entire RFI/CMS process at OU 1085 is provided in Table I-1.

TABLE I-1

PROJECTED SCHEDULE FOR CORRECTIVE ACTION

PROCESS FOR OU 1085

MILESTONE	DATE
Submit EPA/NMED work plan	05/23/94
Start RFI	08/15/95
Start RFI report	03/04/96
Complete RFI fieldwork	07/02/97
Complete draft RFI report	08/20/97
Complete RFI	06/05/98
Complete assessment	08/19/97

Where possible, fieldwork has not been scheduled between November 15 and March 15 each year, to allow for inclement weather.

I.13 Reporting

Results of RFI fieldwork will be presented in four principal documents: quarterly technical progress reports, RFI phase reports/work plan modifications, the RFI report, and the CMS report if required. The purpose of each of these reports is detailed below. A schedule for submission of draft and final reports is presented in Table I-2.

TABLE I-2

REPORTS PLANNED FOR OU 10885 RFI

REPORT TYPE	EPA	DOE	DATE DUE
Monthly reports	X	X	25th of the following month
Quarterly reports	X		February 15, yearly
	X		May 15, yearly
	X		August 15, yearly
Annual reports	X	X	November 15, yearly
Phase reports			
Draft RFI work plan	X	X	5/23/94
Draft Phase I report	X	X	as in baseline; DOE milestone
Draft RFI report	X	X	as in baseline; DOE milestone

I.1.3.1 Quarterly Technical Progress Reports

As the OU 1085 RFI is implemented, technical progress will be summarized in quarterly technical progress reports, 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 RFI phase report/work plan modifications.

I.1.3.2 RFI Phase Report/Work Plan Modifications

RFI phase reports/work plan modifications will be submitted for work conducted on aggregates of SWMUs or on individual SWMUs. These phase reports will serve as partial RFI Phase I reports summarizing the results of initial site characterization activities and as partial RFI Phase II work plans describing the follow-on activities being planned (including any modifications to field sampling plans suggested by initial findings).

I.1.3.3 RFI Report

The RFI report will summarize all fieldwork conducted during the five-year duration of the RFI. As required by the HSWA Module of the Laboratory's RCRA Part B operating permit (Task V, D, p. 46), the Laboratory will submit an RFI report within 60 days of completion of the RFI. As stated in the IWP, Subsection 3.5.1.2 (LANL 1992, 0768), the RFI report will describe the procedures, methods, and results of field investigations and will include information on the type and extent of contamination, sources and migration pathways, and actual and potential receptors. The report will also contain adequate information to support justification for no further action and corrective action decisions for SWMUs.

I.1.3.4 CMS Report

The CMS report will propose methods of remediation for selected SWMUs listed in the RFI report. Not all SWMUs 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.

I.1.4 Budget

The schedule presented above is based on fixed budgets for the first two years of the RFI. The fixed budgets in fiscal years 1993 and 1994 (FY93 and FY94) are based on expected DOE funding levels. DOE funding requests are set two years in advance: thus, the first year in which the RFI is not constrained by past budget estimates will be FY95. Funding requests for FY95 and beyond will reflect the cost and schedule that most efficiently complete the RFI plans. Table ES-1, Executive Summary, presents a cost estimate for the OU 1085 RFI. Schedules and costs will be updated through DOE change control procedures as appropriate with revisions submitted to the EPA for approval.

I.1.5 Organization

The organizational structure for the ER Program is presented in Section 3.0 and Annex I of the IWP. Organization of the ER Program is presented in Figure 3-2 of the IWP (LANL 1992, 0768). See Figure I.5-1 and I.5-2 of this work plan.

This section details the management organization for the OU 1085 RFI. A listof of contributors to the OU 1085 RFI Work Plan is in Appendix B.

The following are the responsibilities of the program manager, programmatic project leader, technical team, field team leaders, and field teams.

Program Manager

- Ensures that the Laboratory's ER activities are consistent with the goals and objectives of the EM Division Leader, DOE, EPA, NMED, and others, as appropriate;
- Ensures compliance with the HSWA Module;
- Ensures compliance with change control procedures;
- Evaluates costs, schedules, and performance;
- Submits monthly and quarterly reports to DOE, EPA, and NMED;
- Tracks deliverables and milestones established by DOE, EPA, and NMED;
- Ensures the establishment and implementation of the quality, health and safety, records management, and community relations programs; and,
- Ensures that policies, guidance, and relevant information are communicated to ER personnel by
    - periodically conducting meetings,
    - distributing essential guidance memoranda and letters, using a receipt acknowledgment system when necessary,
    - ensuring the preparation and controlled distribution of administrative procedures, and,
    - establishing a standard routing system for routine guidance.

Programmatic Project Leader

The programmatic project leader provides technical and administrative programmatic guidance to operable unit project leaders and technical team leaders including the following:

- Meeting regulatory compliance requirements (especially RCRA and CERCLA), RFI/CMS/CMI, document content, administrative and technical standard operating procedures, quality assurance and health and safety requirements, and general policies and requirements for doing business in the Laboratory's ER Program;

- Defining allocation of resources to Laboratory and contractor personnel to accomplish required technical and management activities, and tracking progress and fiscal spending;

- Sssisting operable unit project leaders (OUPLs) and technical team leaders (TTLs) in obtaining appropriate and sufficient resources to perform their assigned duties;

- Performing technical and policy reviews of documents prepared for the ER Program by OUPLs, TTLs, and affiliated staff;

- Rviewing and recommending management action for scopes of work, proposals, or requests for work to be supported by the ER Program;

- Rviewing progress of OUPLs and TTLs;

- Recommending to management, corrective or enhancement actions to expeditiously meet ER Program goals;

- Working closely with other programmatic project leaders and group leaders to assure proper integration of program activities and fiscal responsibility, and to ensure compliance with applicable federal and state regulations;

- Interacting with federal and state regulatory agencies; and,

- Providing input to monthly, quarterly, and/or annual progress reports as required.

OU 1085 Project Leader

Responsibilities of OU 1085 Project Leader are as follows:

- Oversees day-to-day operations, including planning, scheduling, and reporting technical and related administrative activities;

- Ensures preparation of scientific investigation planning documents and procedures;

- Prepares monthly and quarterly reports for the project manager;

- Oversees subcontractors, as appropriate;

- Coordinates with technical team leaders;

- Conducts technical reviews of the milestones and final reports;
- Interfaces with the ER quality program project leader to resolve quality concerns and to coordinate with the quality assurance (QA) staff for audits;
- Complies with the ER Program Health and Safety (H&S), records management, and community relations requirements;
- Oversees RFI fieldwork and manages the field teams manager; and,
- Complies with the Laboratory's technical and QA requirements for the ER Program.

Technical Team Members

Technical team members are responsible for providing technical input for their discipline throughout the RFI/CMS process. They have participated in the development of this work plan and the individual field sampling plans and will participate in the fieldwork, data analysis, report preparation, work plan modifications, and planning of subsequent investigations as necessary.

The primary disciplines currently represented on the technical team are hydrogeology, statistics, geochemistry, and health physics. The composition of the technical team may change with time as the technical expertise needed to implement the RFI changes.

Field Teams Manager

- Oversees day-to-day field operations;
- Conducts planning and scheduling for the implementation of the RFI field activities detailed in Chapters 4 and 5; and,
- Manages field team members.

Field Team Leader

The field teams manager will assign fieldwork to field team leaders for implementation in the field. Each field team leader will direct the execution of field sampling activities using crews of field team members appropriate for the activity. Field team leaders may be contractor personnel.

Field Team Member(s)

Field team members may include

- Sampling personnel,
- Site safety officer,
- Geologists,
- Hydrologists,
- Health physicists, and
- Other applicable disciplines.

All teams will have, at a minimum, 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 leader. Field team members may be contractor personnel.

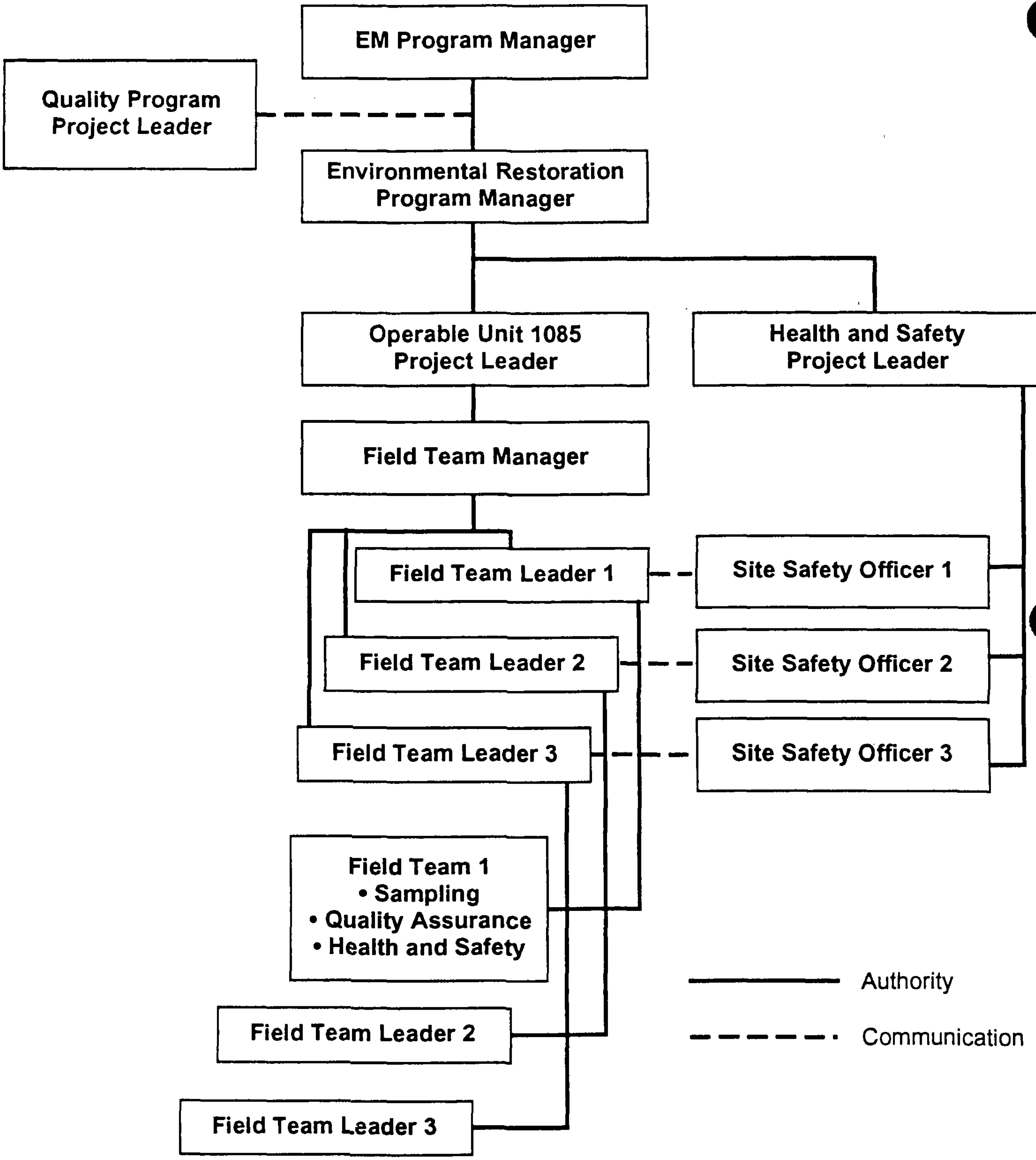

Figure I.5-1 Operable Unit 1085 field work organization chart

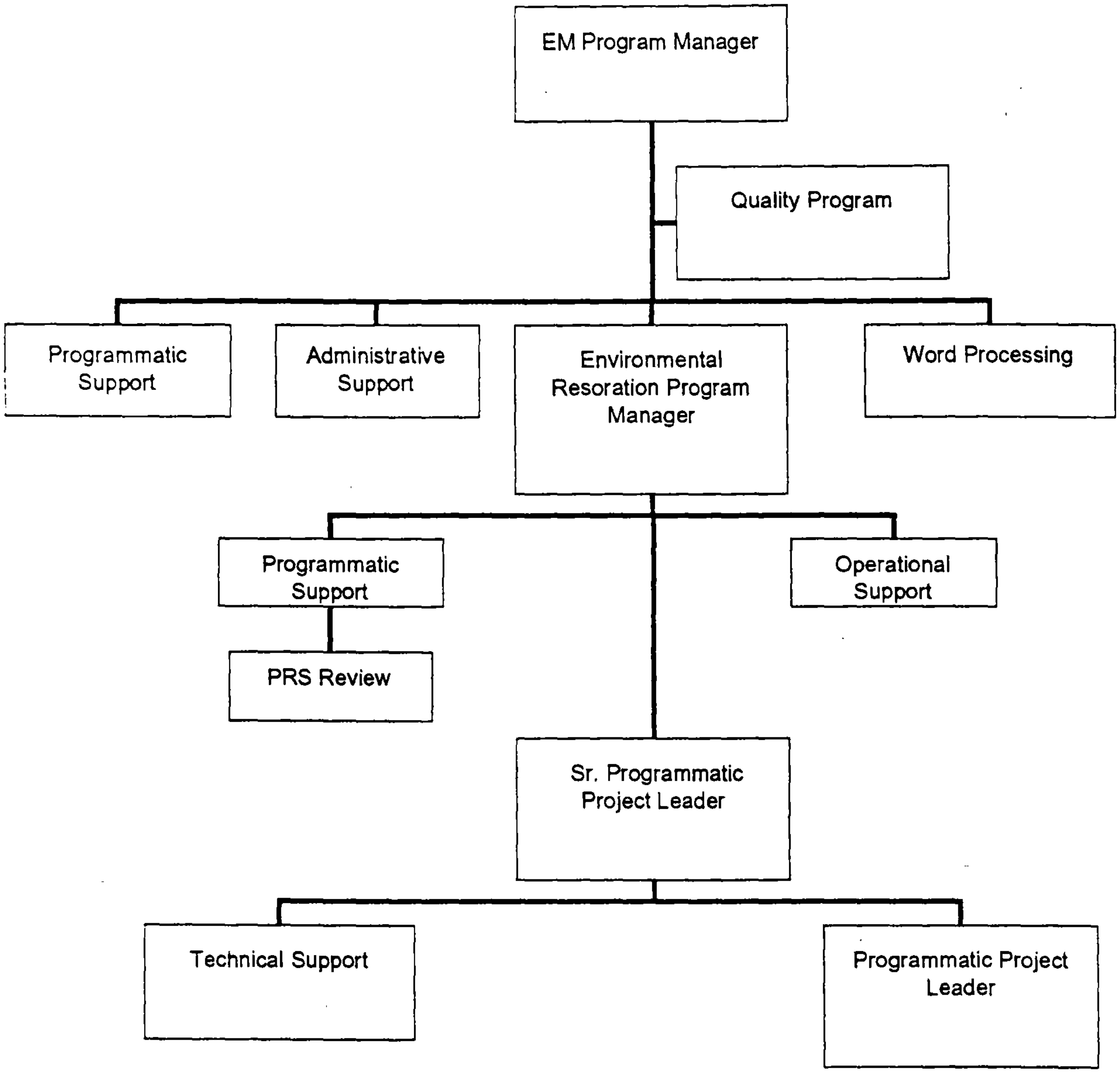

Figure I.5-2 Laboratory ER Program Organizations

REFERENCES

EPA (US Environmental Protection Agency), April 10, 1990. RCRA Permit No. NM0890010515, EPA Region 6, issued to Los Alamos National Laboratory, Los Alamos, New Mexico, effective May 23,1990, EPA Region 6, Hazardous Waste Management Division, Dallas, Texas. (EPA 1990, 0306)

LANL (Los Alamos National Laboratory), November 1992. "Installation Work Plan for Environmental Restoration," Revision 2, Los Alamos National Laboratory Report LA-UR-92-3795, Los Alamos, New Mexico. (LANL 1992, 0768)

ANNEX II

APPROVAL FOR IMPLEMENTATION

II.0 APPROVAL FOR IMPLEMENTATION

1. NAME: Robert Vocke
   TITLE: ER Program Manager, Los Alamos National Laboratory

   SIGNATURE: ____________________ DATE: ____________

2. NAME: Ted Norris
   TITLE: Acting Quality Program Project Leader, ER Program, Los Alamos National Laboratory

   SIGNATURE: ____________________ DATE: ____________

3. NAME: Craig Leasure
   TITLE: Group Leader, Health and Environmental Chemistry Group (EM-9), Los Alamos National Laboratory

   SIGNATURE: ____________________ DATE: ____________

4. NAME: Margaret Gautier
   TITLE: Quality Assurance Officer, Health and Environmental Chemistry Group (EM-9), Los Alamos National Laboratory

   SIGNATURE: ____________________ DATE: ____________

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: Scott Kinkead
   TITLE: Operable Unit Project Leader, CLS-DO, Los Alamos National Laboratory

   SIGNATURE: ____________________ DATE: ____________

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A list of the recipients of the official copies of this plan and any subsequent revisions will be developed and maintained as a document control activity.

INTRODUCTION

This Quality Assurance Project Plan (QAPjP) for the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Work Plan for Operable Unit (OU) 1085 was written as a matrix report (Table II-1) that is based on the Los Alamos National Laboratory (the Laboratory) Environmental Restoration (ER) Program generic QAPjP.

The Laboratory ER Program generic QAPjP describes the format for the individual OU QAPjPs. Section 2.0 of the generic QAPjP is the table of contents, which was omitted from this annex because the OU 1085 QAPjP is presented as a matrix. Section 3.0 of the generic QAPjP 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 1085 QAPjP matrix (Table II-1) lists the generic QAPjP criteria in the first column; these criteria correspond to the sections of the generic QAPjP. The second column lists the specific requirements of the generic QAPjP that the OU 1085 QAPjP must meet; the subsection titles and numbers in the second column correspond directly with those contained in the generic QAPjP. Sections of the generic QAPjP that do not contain specific requirements (e.g., 3.4) are not included in the matrix. The third column lists the location in the IWP and/or the OU 1085 work plan of information that fulfills the requirements in the generic QAPjP. If OU 1085 will follow the requirements in the generic QAPjP and no further information is necessary, the column contains the phrase "generic QAPjP accepted." In some cases, a standard operating procedure (SOP) and/or a clarification note is included.

Note 1: Section 4.0 Project Organization and Responsibility

The organizational structure of the ER Program is presented in Section 2.0 of the LANL ER Quality Program Plan (QPP) to the project leader (PL) level, including quality assurance (QA) functions. The OU 1085 work plan, Annex I, describes the organizational structure from the PL level down, and presents an organizational chart to demonstrate line authority.

Note 2: Section 6.1 Quality Control Samples

If soil samples for geotechnical analyses are collected during the OU 1085 RFI, then the following QA procedures will be used. In contrast to samples submitted for chemical analyses, field quality control samples are not routinely associated with geotechnical samples. Quality control (QC) for geotechnical sample-analysis results is prescribed in the specific laboratory procedure. An additional measure of QC for geotechnical samples is achieved by the collection and submittal of a larger-than-sufficient volume of sample. A large sample volume may provide for reanalysis of an individual sample in the event that results from the initial aliquot did not meet specific method requirements.

QA and QC sampling for RFI Phase I in OU 1085 will provide samples to address variability in the sampling and analytical procedures. Most of these will be prescribed generically as follows:

- Rinsate samples (in general, one per day) will be collected if on-site decontamination of sampling equipment is being performed.
- A trip blank (one per sample delivery group) will be included whenever volatile organic compounds are a potential contaminant at the site.
- Field reagent blanks will be submitted only if reagents are brought in bulk to the site and measured out on site.
- The Sample Coordination Facility (SCF) will add blanks, surrogate spikes, and other QA samples to each batch following its standard practices. (Batch sizes will be determined by the SCF and will vary depending on the type of analyses to be performed. The SCF will attempt to keep samples from a sample delivery group together as much as possible when batching samples for the analytical laboratories.)
- The analytical laboratories will report analyses of instrument blanks, calibration standards, and other QC samples as specified in their contracts with the SCF.
- Field instrument calibration checks will be performed as specified in the SOPs controlling the use of those instruments. The results will be recorded in the field documentation of the survey.
- The field laboratories will provide laboratory splits, replicate analyses, and calibration checks as specified by their SOPs or QC programs. The results will be documented and reported to the field team leader.

In general, the QA/QC samples listed above are at most single blind samples.

The only types of QA sampling that are described in site-specific detail in Chapter 5 are double blind collocated samples, field splits, and field duplicates to be prepared in the field for both field and off-site laboratories. We define these as follows:

- A collocated sample is a second sample collected next to the first sample, as close as practicable (usually 1 to 2 ft away), using the same method as the first (another spade or scoop sample, another manual shallow core, etc.). In general, subsamples for the collocated sample are prepared for each proposed analysis as for the first sample.

- A field split is a second subsample collected in the field from a prepared (e.g., homogenized) sample for a designated type of analysis. This can be appropriate for inorganic, radionuclide, and most semivolatile organic analyses, but in general is not useful for volatile organic analyses.

- A field duplicate is a second subsample collected for a minimally disturbed field sample (usually a core) for a designated type of analysis. Field duplicates are used in place of field splits for volatile compounds.

Collocated samples provide an estimate of "total study error" (apart from overall population variability, which is captured by taking a number of samples from the site). Field splits and field duplicates are used to estimate incremental error introduced by imperfect homogenization, handling, transport, and analysis. Field duplicates and collocated samples provide estimates of micro-scale variability of contaminants such as radionuclides in sediments and dioxins in soil.

Note 3: Section 14.3 Sample Representativeness

The field sampling plans presented in the OU 1085 work plan, Chapter 5, were developed to meet the sample representativeness criteria described in Subsection 14.3 of the Laboratory ER Program generic QAPjP (Quality Program Plan and Quality Assurance Project Plan for Environmental Restoration, January 1993) (LANL 1993, 1017).

Note 4: Section 16.1 Field Quality Assurance Reports to Management

The OU field teams leader or a designee will provide a monthly field progress report to the ER PL. This report will consist of the information identified in Subsection 16.1 of the ER Program generic QAPjP (Quality Program Plan and Quality Assurance Project Plan for Environmental Restoration, January 1993) (LANL 1993, 1017).

TABLE II-1
OU 1085 QAPjP MATRIX

GENERIC QAPjP CRITERIA	GENERIC QAPjP[1] REQUIREMENTS BY SUBSECTION	OU 1085 INCORPORATION OF GENERIC QAPjP REQUIREMENTS
Project description	3.2 Facility Description	Los Alamos National Laboratory (LANL) ER Program IWP[2], Section 3.0, and OU 1085 Work Plan, Chapter 2
	3.3 ER Program	LANL ER Program IWP, Section 2.0
	3.4.1 Project Objectives	OU 1085 Work Plan, Chapters 1 and 5
	3.4.2 Project Schedule	OU 1085 Work Plan, Annex I
	3.4.3 Project Scope	OU 1085 Work Plan, Chapters 1 and 5
	3.4.4 Background Information	OU 1085 Work Plan, Chapters 1, 2, and 3
	3.4.5 Data Management	OU 1085 Work Plan, Annex IV, and LANL ER Program IWP, Annex IV
Project organization	4.1 Line Authority	OU 1085 Work Plan, Annex I
	4.2 Personnel Qualifications, Training, Resumes	Maintained as records within OU 1085 record system
	4.3 Organizational Structure	LANL-ER-QPP, Section 2.0, *Note 1.*
Quality assurance objectives for measurement data in terms of precision, accuracy, representativeness, completeness, and comparability	5.1 Level of Quality Control	Generic QAPjP accepted
	5.2 Precision, Accuracy, and Sensitivity of Analyses	Generic QAPjP accepted
	5.3 QA Objectives for Precision	Generic QAPjP accepted
	5.4 QA Objectives for Accuracy	Generic QAPjP accepted
	5.5 Representativeness, Completeness, and Comparability	Generic QAPjP accepted
	5.6 Field Measurements	Generic QAPjP accepted
	5.7 Data Quality Objectives	OU 1085 Work Plan, Chapter 5
Sampling procedures	6.0 Sampling Procedures	OU 1085 Work Plan, Appendix E
	6.1 Quality Control Samples	Generic QAPjP accepted including ER Program SOP-01.05. See also *Note 2.*
	6.2 Sample Preservation During Shipment	Generic QAPjP accepted including ER Program SOP-01.02
	6.3 Equipment Decontamination	Generic QAPjP accepted
	6.4 Sample Designation	Generic QAPjP accepted including ER Program SOP-01.04
Sample custody	7.1 Overview	Generic QAPjP accepted including ER Program SOP-01.04
	7.2 Field Documentation	Generic QAPjP accepted including ER Program SOP-01.04
	7.3 Sample Management Facility	Generic QAPjP accepted
	7.4 Laboratory Documentation	Generic QAPjP accepted
	7.5 Sample Handling, Packaging, and Shipping	Generic QAPjP accepted including ER Program SOP-01.03
	7.6 Final Evidence File Documentation	Generic QAPjP accepted
Calibrations procedures and frequency	8.1 Overview	Generic QAPjP accepted
	8.2 Field Equipment	Generic QAPjP accepted
	8.3 Laboratory Equipment	Generic QAPjP accepted

Table II-1 (continued)

GENERIC QAPjP CRITERIA	GENERIC QAPjP[1] REQUIREMENTS BY SUBSECTION	OU 1085 INCORPORATION OF GENERIC QAPjP REQUIREMENTS
Analytical procedures[3]	9.1 Overview	Generic QAPjP accepted
	9.2 Field Testing and Screening	Generic QAPjP accepted including ER Program SOP-06.02
	9.3 Laboratory Methods	Generic QAPjP accepted. Sample methods are described in OU 1085 Work Plan, Appendix E
Data reduction, validation, and reporting	10.1 Data Reduction	Generic QAPjP accepted
	10.2 Data Validation	Generic QAPjP accepted
	10.3 Data Reporting	Generic QAPjP accepted
Internal quality-controlled checks	11.1 Field Sampling Quality Control Checks	Generic QAPjP accepted
	11.2 Laboratory Analytical Activities	Generic QAPjP accepted
Performance and system audits	12.0 Performance and System Audits	Generic QAPjP accepted
Preventive maintenance	13.1 Field Equipment	Generic QAPjP accepted
	13.2 Laboratory Equipment	Generic QAPjP accepted
Specific routine procedures used to assess data precision, accuracy, representativeness, and completeness	14.1 Precision	Generic QAPjP accepted
	14.2 Accuracy	Generic QAPjP accepted
	14.3 Sample Representativeness	Generic QAPjP accepted. See also *Note 3.*
	14.4 Completeness	Generic QAPjP accepted
Corrective action	15.1 Overview	Generic QAPjP accepted including LANL-ER-QP-01.3Q
	15.2 Field Corrective Action	Generic QAPjP accepted
	15.3 Laboratory Corrective Action	Generic QAPjP accepted
Quality assurance reports to management	16.1 Field Quality Assurance Reports to Management	Generic QAPjP accepted. See also *Note 4.*
	16.2 Laboratory Quality Assurance Reports to Management	Generic QAPjP accepted
	16.3 Internal Management Quality Assurance Reports	Generic QAPjP accepted

1 LANL 1991, 0553
2 LANL 1992, 0768
3 Although the generic QAPjP criteria are accepted, special sampling limits, parameters, and analyses will be established for operable unit-specific cases. See the note at the top of page 9-2, Generic QA Project Plan (LANL 1991, 0553).

REFERENCES

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 III

HEALTH AND SAFETY PROJECT PLAN

III.1 INTRODUCTION

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.2.2.1 Environmental Management and Health and Safety Division Leaders

The Environmental Management (EM) and Health and Safety Division Leaders are responsible for addressing programmatic health and safety concerns. They 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.

III.2.2.2 Environmental Restoration Program Manager

The ER Program Manager (EM-13) 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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.3.0 SCOPE OF WORK

III.3.1 Comprehensive Work Plan

The IWPHSPP for ER targets OU 1085 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.

III.3.2 Operable Unit Description

OU 1085 consists of 6 potential release site (PRS) aggregates. These include solid waste management units and areas of concern. 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 1—Firing Site
2. Aggregate 2—Radioactive Lanthanum
3. Aggregate 3—Western Area at TA-14
4. Aggregate 4—Central TA-14 Firing Site
5. Aggregate 5—Inactive Septic Tank TA-14-19
6. Aggregate 6—Decommissioned Firing Sites

III.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

Table III-1. Summary of PRSs, OU 1085

DESCRIPTION	TASKS	CHEMICALS OF CONCERN	RADIONUCLIDES OF CONCERN
Firing Site, Aggregate 1	Soil sampling	High explosive residuals, barium, beryllium, cadmium, chromium, lead, uranium	Uranium 235, 238
Radioactive Lanthanum, Aggregate 2	Soil sampling	High explosive residuals, barium, beryllium, cadmium, chromium, lead, uranium	Strontium
Western Area at TA-14, Aggregate 3	Soil sampling	High explosive residuals, beryllium, lithium, copper, lead, uranium	
Inactive Septic Tank, Aggregate 5	Soil sampling	High explosive residuals, antimony, barium, beryllium, cadmium, chromium, copper, lead, uranium	Uranium 235
Central TA-14 Firing Site, Aggregate 4	Soil sampling	High explosive residuals, barium, lead	Uranium 235, 238
Decommissioned Firing Sites, Aggregate 6	Soil, debris sampling	Beryllium, lead, uranium, high explosive residuals	Uranium 235, 238
Decommissioned Magazines, Aggregate 6	Soil sampling	High explosive residuals, lead, barium, antimony, chromium, copper	

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.

III.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.

III.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.

TABLE III-2
PHYSICAL HAZARDS OF CONCERN, OU 1085

HAZARD DESCRIPTION	PERSONAL PROTECTIVE EQUIPMENT	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
Fire/explosion	Hard hat, gloves, face shield, fire-resistant full-body suit	Ventilation, containment 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	PPE. 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	Visual, combustible gas meter, photoionization 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 surface, 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
Heavy equipment	Hard hat, safety shoes, gloves	Operator training. Stay clear of energized sources, PPE, back-up alarm, orange vest	Observation of work practices
Heat stress	Hat, cooling vest	ACGIH work/rest regimens, PPE	Wet bulb glove 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, PPE	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

NIOSH et al. 1985, 0414; Plog 1988, 0943; OSHA 1989, 0946

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.

III.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.

III.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).

TABLE III-3
CHEMICAL CONTAMINANTS OF CONCERN

CONTAMINANT	EXPOSURE LIMIT	IDLH	SYMPTOMS OF EXPOSURE	ROUTES OF EXPOSURE	IP(EV)	MONITORING INSTRUMENT	RELATIVE RESPONSE
Antimony	0.5 mg/m^3	80 mg/m^3	Irritation of nose, throat, and mouth, dizziness, headache, nausea	Inhalation, skin contact, ingestion	N/A	Sampling pump, filter, NIOSH 261	N/A
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	N/A
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	N/A
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	N/A
Chromium[c]	0.5 mg/m (di- and tri-valent), 0.05 mg/m^3 (hexavalent compounds) 0.1 mg/m^3 - ceiling	N/A 30 mg/m^3	Fibrosis, dermatitis, perforation of nasal septum, respiratory system irritation, carcinogen	Inhalation, ingestion, skin contact		Sampling pump, filter AA or IC, NIOSH 7024	N/A
Chromium metal[c]	0.5 mg/m^3	N/A	Histologic fibrosis of lungs	Inhalation, ingestion	None	MCEF, AA, NIOSH Method 7024	N/A
Copper	1.0 mg/m^3 (dust and mist) 0.1 mg/m^3 (fume)	None	Irritation of nasal mucus membrane, pharynx, nasal perforation, dermatitis	Inhalation, ingestion, skin contact	None	MCEF, AA, NIOSH Method 7029	N/A

Confined space entry	Gloves, boots, full-body suit, supplied-air or self-contained breathing apparatus, safety glasses, life line	Ventilation, oxygen, combustible gas monitoring, confined space permit, PPE	Combustible gas meter, oxygen monitors
Trenching	Hard hats, safety shoes, safety glasses	Protective shoring, proper excavation access, egress, PPE	Visual, oxygen meter, determining soil type
Welding/ cutting/ brazing	Fire-resistant gloves and clothing (aprons, coverall, leggings), welding helmets or goggles	Ventilation, PPE	Personal sampling for metal fumes

CONTAMINANT	EXPOSURE LIMIT	IDLH	SYMPTOMS OF EXPOSURE	ROUTES OF EXPOSURE	IP(EV)	MONITORING INSTRUMENT	RELATIVE RESPONSE
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	N/A
Lithium hydride	0.025 mg/m^3	55 mg/m^3	Skin and eye burns, blurred vision, mental confusion, nausea	Inhalation, ingestion, skin contact	None	Filter, sampling pump AA, OSHA IMIS 1503	N/A

[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

ACGIH 1992, 0858; Clayton and Clayton 1981, 0939; Eller 1984, 0944; OSHA 1991, 0610; NIOSH 1990, 0941

AA = atomic absorption
ACGIH = American Conference of Governmental Industrial Hygienists
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
TLV = threshold limit value
TWA = time weighted average

III.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.

III.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, giardia lamblia, and black widow spiders. Table III-5 summarizes some of the potential biological hazards for this OU.

III.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:

- hand augering,
- septic system sampling,
- high explosive sampling, and
- canyon side sampling.

Other tasks should be considered for inclusion by the SSO.

Table III-4
Radionuclides of concern

RADIONUCLIDE	MAJOR RADIATION	DAC (µCI/ML)	RADIOACTIVE HALF-LIFE	MONITORING INSTRUMENT
Strontium-90	Beta	2×10^{-9}	27.7 years	Liquid scintillation counter
Uranium-235	Alpha, gamma	2×10^{-11}	7×10^{8} years	Alpha scintillometer, FIDLER
Uranium-238	Alpha, gamma	2×10^{-11}	4.5×10^{9} years	Alpha scintillometer, FIDLER

DAC = derived air concentration (DOE Order 5480.11)
FIDLER = field instrument for the detection of low-energy radiation

Table III-5
Biological hazards of concern, OU 1085

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)	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 (prairie dogs and squirrels may carry plague infected fleas)	Long pants, boots	Do not handle live or dead rodents
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
Blood-borne pathogens (blood, blood products, and human body fluids may contain Hepatitis B virus or HIV)	Latex gloves, mouth guards, protective eyewear	Only trained personnel should perform first aid procedures. Follow Laboratory blood-borne 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 infection agents (stream water may contain giardia)	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

III.5.0 SITE CONTROL

III.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.

III.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.

III.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.

III.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.

III.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.

III.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 Field Safety Coordinator, will be immediately dismissed from the site.

III.5.7 Specific Safe-Work Practices

III.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 4 inches for every 10 kV over 50 kV. For underground electrical service the underground locator service should be contacted before digging.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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, washing, 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.

Table III-6

Illumination levels

FOOT-CANDLES	AREAS OF OPERATION(S)
5	General site areas
3	Excavation and waste areas, access ways, active storage areas, loading platforms, refueling areas, field maintenance areas
5	Indoors (warehouses, corridors, hallways, exits)
5	Tunnels, shafts, and general underground work areas. (Exception: a minimum of 10 ft-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, indoor toilets, and workrooms)
30	First aid stations, infirmaries, offices

III.5.7.8 Packaging and Transport

The OUPL should contact HS-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 HS-7.

III.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.

III.5.7.10 Extended Work Schedules

Scheduled work outside normal work hours must have the prior approval of the OUPL and SSO.

III.5.8 Permits

III.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.

III.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
- Confined Space Entry
- Lockout/Tagout

III.6.0 PERSONAL PROTECTIVE EQUIPMENT

III.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). These regulations are reinforced by EPA regulation 40 CFR Part 300, which requires private contractors working on Superfund sites to conform to applicable OSHA provisions and any other federal or state safety requirements deemed necessary by the lead agency overseeing the activities.

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.

III.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.

III.6.1.1 Medical Certification

Medical approval may be required before donning certain PPE. See Section 9 for more details.

III.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.

TABLE III-7

OSHA STANDARDS FOR PPE USE

TYPE OF PROTECTION	REGULATION
General	29 CFR 1910.132 29 CFR 1910.1000 29 CFR 1910.1001-1045
Eye and face	29 CFR 1910.133(a)
Hearing	29 CFR 1910.95
Respiratory	29 CFR 1910.134
Head	29 CFR 1910.135
Foot	29 CFR 1910.136
Electrical protective devices	29 CFR 1910.137

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 changed 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.

III.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.

III.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.

III.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.

III.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.

III.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. (Parmeggianl 1983, 0945)

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.

III.7.0 HAZARD CONTROLS

III.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

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 set 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 non-permeable), rubber boots	Double set of PC, nonpermeable outer clothing, rubber boots

reducing hazards to workers, such as guarding moving parts on machinery and tools or using ventilation during confined space entry.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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 4380.11 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.

III.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.

III.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.

III.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 4380.11). 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.

III.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.

III.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.

III.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.

III.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.

III.9.0 MEDICAL SURVEILLANCE AND MONITORING

III.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.

III.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.

III.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.

III.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.

III.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.

III.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.

III.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 provisions of HS-12. These provisions are outlined in the following sections. (Monitoring and control of internal contamination by hazardous chemical contaminants is included in the medical surveillance program.)

III.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.

III.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.

III.11.0 DECONTAMINATION

III.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.

III.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.

III.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.

III.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

III.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.

III.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.

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 protective clothing.

- **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.

III.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.

III.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.

III.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.

III.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 provided the maximum activity in any area of 100 cm^2 is less than three times the guide values.

III.11.3 Equipment Decontamination

III.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.

III.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.

III.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.

III.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.

III.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 Division procedures.

III.12.0 EMERGENCIES

III.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.

III.12.2 Emergency Response Plan

The Laboratory Emergency Management Office 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 site safety officer, 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 1085 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 1085 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 1085 work area would be required; in most instances a safe distance may be established to protect personnel.

III.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 safety 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 site safety officer 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 site safety officer will be responsible for this task. At that time, the site safety officer 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 site safety officer will be responsible for this task, and will be given instructions by the site safety officer. 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 20% of the lower explosive limit, personnel will be evacuated. The site safety officer will continue monitoring to determine when equipment should be removed or when personnel may re-enter the area and resume work.

III.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 (as outlined in Section 4.6.2). 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.

III.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 attached to 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.

III.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.

III.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.

III.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:

Table III-11. Emergency Contacts

Site Safety Officer Name:	Pager: 104-6579 Call: 665-5144
Environmental Restoration Health and Safety Project Leader Name:	Pager: 104-6579 Call: 665-5144
24-Hour LANL Health/Safety Coordinator Call:	Pager: 104-1123 Call: 667-4512 (work) 672-3659 (home)

- **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 or 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).

III.13.0 PERSONNEL TRAINING

III.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 activities.

III.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 (Parmeggianl 1983, 0945)

III.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.

III.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.

III.13.2.3 Annual Refresher

All persons required to have OSHA training shall receive 8 hours of refresher training annually.

III.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).

III.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.

III.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.

III.13.5 High Explosives Training

At PRSs where high explosives are known or suspected to be present, additional safety training may be required.

III.13.6 Facility-Specific Training

Certain areas of the Laboratory (e.g., firing sites) require additional facility specific training before personnel can enter.

III.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 his designee is responsible for ensuring that persons entering the site are properly trained.

Table III-12
Training topics

INITIAL SITE-SPECIFIC	WEEKLY	PERIODIC AS WARRANTED	TOPIC
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	Personal protective equipment, 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)
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

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NIOSH (National Institute for Occupational Safety and Health), September, 1985. "NIOSH Pocket Guide to Chemical Hazards," US Department of Health and Human Services, DHHS (NIOSH) Publication 85-114. (NIOSH 1985, 0709)

OSHA (Occupational Safety and Health Administration), July 1, 1991. "Hazardous Waste Operations and Emergency Response," Code of Federal Regulations, Title 29, Part 1910, Washington, DC (OSHA 1991, 0610)

Plog, B. A. 1988. Fundamentals of Industrial Hygiene, Third Edition, National Safety Council, Chicago, Illnois. (Plog 1988, 0943)

ANNEX IV

RECORDS MANAGEMENT PROJECT PLAN

RECORDS MANAGEMENT PROJECT PLAN

IV.1.0 INTRODUCTION

The Records Management Plan (RMP) for the Environmental Restoration (ER) Program at Los Alamos National Laboratory (the Laboratory) is described in Annex IV of the Installation Work Plan (IWP) (LANL 1993, 1017). The purposes of the RMP are to meet the requirements for protecting and managing records (including technical data), to provide an ongoing tool to support the technical efforts of the ER Program, and to function as a support system for management decisions throughout the existence of the ER Program.

In the ER Program, the following statutory definition of a record (44 USC 3301) is used.

Records are defined as "...books, papers, maps, photographs, machine-readable materials, or other documentary materials, regardless of physical form or characteristics,...appropriate for preservation...because of the informational value of the data in them."

The RMP establishes general guidelines for managing records, regardless of their physical form or characteristics, that are generated and/or used by the ER Program. The RMP will be implemented consistently to meet the requirements of the Quality Assurance Program Plan (Annex II of the IWP) and to provide an auditable and legally defensible system for records management. Another important function of the RMP is to maintain the publicly accessible documentation comprising the Administrative Record required by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).

IV.2.0 Implementation of the Records Management Plan

Chapter 2 of the RMP describes the implementation of the records management program. Records management activities for Operable Unit (OU) 1085 will follow the guidelines summarized in that chapter. As the RMP develops to support OU needs, additional detail will be provided in annual updates of the IWP.

The RMP incorporates a threefold approach based on records control and commitment to quality guidelines: a structured work flow for records, the use of approved procedures, and the compilation of a referable information base. ER Program records are those specifically identified in quality procedures (QPs), administrative procedures (APs), standard operating procedures (SOPs), ER RMPs; management guidance documents, or records identified by ER Program participants as being essential to the program. Records are processed in a structured work flow. The records management procedure (LANL-ER-AP-02.1) governs records management activities, which include records identification, submittal, review, indexing, retention, protection, access, retrieval, and correction (if necessary). Other procedures, such as LANL-ER-AP-01.3, LANL-ER-AP-01.4, and LANL-ER-AP-01.5, are also followed.

Records (including data) will be protected in and accessed through the referable information base. The referable information base is composed of the Records-Processing Facility (RPF) and the Facility for Information Management, Analysis, and Display (FIMAD). RPF personnel receive ER Program records, assign an ER identification number, and process records for delivery to the FIMAD. The RPF will complement FIMAD in certain aspects of data capture, such as scanning. The RPF also functions as an ER Program reference library for information that is inappropriate either in form (e.g. old records) or in content (e.g., Federal Register) for storage at the FIMAD. FIMAD provides the hardware and software necessary for data capture, display, and analysis. The information will be readily accessible through a network of work stations. Configuration management accounts for, controls, and documents the planned and actual design components of FIMAD.

IV.3.0 Use of ER Program Records Management Facilities

The Environmental Restoration Program's RPF and FIMAD facilities will be utilized for management of records resulting from the conduct of work on Operable Unit 1085. Interaction with these facilities is detailed in LANL -ER-AP-2.01, Annex IV of the Installation Work Plan, and other Program procedures and management guidance documents as appropriate.

IV.4.0 Coordination with the Quality Program

Records will be protected throughout the process, as described in Chapter 4 of the RMP and in LANL-ER-AP-02.1. The originator is responsible for protecting records until they are submitted to the RPF. The level of protection afforded by the originator will be commensurate with the value of the information contained in the record. Upon receipt of a record, the RPF will temporarily store the original of the record in one-hour, fire-rated equipment and will provide a copy of the record to the FIMAD. The RPF will then send the original record to a dual storage area for long-term storage in a protected environment.

IV.5.0 Coordination with the Health and Safety Program

Chapter 5 of the RMP notes two exceptions to the records storage process. The Laboratory's Occupational Medicine Group (HS-2) will maintain medical records because of their confidential nature. Training records will be maintained by the RPF in coordination with the Laboratory Training Office (LTO) within the Human Resources Development (HRD) Division. FIMAD will only contain information about the completion of training, the dates of required refresher training, and the location of training records.

IV.6.0 Coordination with the ER Program's Management Information System

Specific reporting requirements are ER Program deliverables and, as such, are monitored through the ER management information system. Records resulting from the conduct of work on operable units contribute to the development of the deliverables.

IV.7.0 Coordination with the Community Relations Program

RCRA and CERCLA require that records be made available to the public. Two complementary approaches are being implemented: hard copy and electronic access. A reading room allows public access to hard copies of key documents. A work station and necessary data links are being prepared to allow public access to the FIMAD data base.

REFERENCE

Los Alamos National Laboratory, November 1993. "Installation Work Plan for Environmental Restoration," Revision 1, Los Alamos National Laboratory Report LA-UR-91-3978, Los Alamos, New Mexico (LANL 1991, 1017).

ANNEX V

PUBLIC INVOLVEMENT PROJECT PLAN FOR OU 1085

ANNEX V: PUBLIC INVOLVEMENT PROJECT PLAN FOR OU 1085

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 Laboratory's public reading room is located at 1450 Central Avenue, Suite 101, Los Alamos, New Mexico. The Public Involvement project leader can be reached at (505) 665-5000 for additional information.

REFERENCE

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

NEPA DOCUMENTATION

APPENDIX A

NATIONAL ENVIRONMENTAL POLICY ACT AND RELATED DOCUMENTS

The NEPA evaluation and document preparation for OU 1085 is an ongoing process. Updates to this section will be made as documents become available.

The status of OU 1085 NEPA work as of April 7, 1994, is as follows:

Descriptive Title	Status of Document
• NEPA	
DOE Environmental Checklist (DEC)	In Progress
• Cultural Resources	
Initial Survey Summary	Submitted, see Section A.1
Final Report	In progress
• Biological Resources	
Initial Survey Report	Submitted, see Section A.2
Final Report	In progress

A.1 CULTURAL RESOURCE SUMMARY

As required by the National Historic Preservation Act of 1966 (as amended), a cultural resource survey was conducted during the summer of 1993 at Operable Unit (OU) 1085. 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* (Federal Register, Vol. 48, No. 190, Thursday, September 29, 1983).

Eight archaeological sites are located in the areas surveyed. Seven of these are eligible for inclusion on the *National Register of Historic Places* under Criterion D, "Potential to Yield Research Data."

The attributes that make these seven sites eligible for inclusion on the *National Register* will not be affected by any Environmental Restoration (ER) Program sampling activities proposed at OU 1085. A report documenting the survey area, methods, results, and monitoring recommendations, if any, will be transmitted to the New Mexico State Historic Preservation Officer (SHPO) 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. This consultation will be documented and included in ER files when completed.

All monitoring and avoidance recommendations contained in the reports referenced below must be followed by all personnel involved in ER sampling activities. Environmental Protection Group (EM-8) archaeologists must be contacted 30 days prior to initiation of any groundbreaking activities so that monitoring and avoidance recommendations can be verified.

A.2 INTRODUCTION AND FURTHER INFORMATION

During 1992 and 1993, field surveys were conducted by the Biological Resource Evaluations Team (BRET) of the Environmental Protection Group (EM-8) for site characterization of Operable Unit (OU) 1085, Technical Areas 14 and 67. The following report summarizes preliminary data analysis regarding floodplain and wetland concerns, the potential for threatened and endangered species, and mitigations to limit impacts.

Site characterization requires surface and subsurface sampling, primarily on the mesa tops within the TA. Surface sampling will be done on or near the south-facing slope of Cañon de Valle and on or near the south-facing slope of Threemile Canyon. No sampling is scheduled to take place in the canyon bottoms of Pajarito, Valle, Twomile, and Threemile Canyons during this phase. Further information concerning the biological field surveys for this OU will be contained in the full report "Biological Assessment for Environmental Restoration Program, OU 1085," which includes specific information on survey methods, results, and mitigation measures. This assessment will also contain information that may aid in defining ecological pathways and vegetation restoration.

A.2.1 Laws

Field surveys were conducted for compliance with the Federal Endangered Species Act of 1973, New Mexico's Conservation Act, New Mexico Endangered Plant Species Act, Executive Order 11990 "Protection of Wetlands" and Executive Order 11988 "Floodplain Management," 10 CFR 1022 and DOE Order 5400.1.

A.2.2 Methods

The purpose of the surveys was threefold. The first was to determine whether any critical habitat for any state or federal sensitive, threatened, or endangered plant or animal species was present within the OU boundaries. The second was to identify any sensitive areas such as floodplains and wetlands within the OU and if present their extent and general characteristics. The third purpose was to provide additional plant and wildlife data concerning the habitat types within the OU.

These data provide further baseline information about the biological components of the site for site characterization and determination of presampling conditions. This information is also necessary to support NEPA documentation and determination of a Categorical Exclusion for the sampling plan for site characterization.

The proposed sampling will include sediment, surface, and subsurface samples. The sediment samples are to be taken from existing sediment basins within a drainage located the OU. Soil samples will be collected from the surface. Subsurface characterization involving boring drill holes greater than 60 feet is projected to occur in TA-14 near 14-006 Sump and 14-007 Septic Tank. The two subsurface sample sites are in disturbed areas.

EM-8 maintains a database containing the habitat requirements for all state and federally listed threatened or endangered plant and animal species known to occur within the boundaries of Los Alamos National Laboratory and surrounding areas. After consulting this database, BRET conducted a Level 2 (habitat evaluation) survey. A Level 2 survey is performed when there are areas within the OU that have not been greatly disturbed and could potentially support threatened or endangered species. Techniques used in a Level 2 survey were designed to gather data on the percentage of cover, and the density and frequency of both the understory and overstory components of the plant community.

The habitat information gathered through the field surveys was then compared to habitat requirements for species of concern as identified in the database search. If habitat requirements were not met, then no further surveys were conducted and the site was considered not to impact on state and federally listed species. If habitat requirements were met, species surveys were done in accordance with preestablished survey protocols. These protocols often require certain meteorological or seasonal conditions (i.e., the survey for grama grass cactus must be done during its flowering season from the end of May into June).

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

A.3.1 Species Identified

Database searches indicated that the species of concern (state- and federally listed threatened or endangered plant and animal species) that are potentially present in this OU are:

- Northern Goshawk (*Accipiter gentilis*-Federal Candidate)
- Bald Eagle (*Haliaeetus leucocephalus*-Federal Endangered)
- Peregrine Falcon (*Falco peregrinus*-Federal Endangered)

- Mexican Spotted Owl (*Strix occidentalis lucida*-Federal Candidate)
- Broad-billed Hummingbird (*Cyanthus latirostris*-State Endangered)
- Willow Fycatcher (*Empidonax trailii*-Federal Candidate)
- Spotted bat (*Euderma maculatum*-State Endangered)
- Wright fishhook cactus (*Mammillaria wrightii*-State Endangered)
- Santa Fe cholla (*Opuntia viridiflora*-State Endangered)
- Grama grass cactus (*Toumeya papyracantha*-State Endangered)
- Sessile-flowered false carrot (*Aletes sessiliflorus*-State Endangered)
- Plank's catchfly (*Silene plankii*-State Sensitive)
- Santa Fe milk-vetch (*Astragalus feensis*-State Endangered)
- Taos milk-vetch (*Astragalus puniceus var. gertrudis*-State Sensitive)
- Cyanic milk-vetch (*Astragalus cyaneus*-State Sensitive)
- Checker lily (*Fritillaria atropurpurea*-State Sensitive)
- Western Wood lily (*Lilium philadelphicum*-State Endangered)
- Pagosa phlox (*Phlox caryophylla*-State Sensitive)

A.4.1 Results and Mitigation

Once specific sampling locations have been identified, surveys for sensitive and endangered plant species must be conducted before any sampling activities are permitted to occur in any critical habitat. BRET must be provided with the location of each sampling site in order to determine the necessity for surveying for a particular plant species. In addition, each plant species has its own seasonal survey restrictions because of its flowering or emergence dates. Therefore, if surveys for particular sensitive plant species are to be conclusive, they must be conducted during those flowering or emergence periods. (Note: BRET conducted habitat evaluations surveys for all listed plants species during the summer of 1992 and 1993. However, survey time may not have coincided with flowering dates of a protected species.)

As a result of a habitat evaluation and previous data on the OU, our preliminary data show that at least three species have potential for occurrence within or near the OU. (Note: The extensive data analysis required for the biological assessment may find other species of concern.) These species are the Northern Goshawk (*Accipiter gentilis)*, Mexican spotted owl (*Strix occidentalis lucida)*, and spotted bat (*Euderma maculatum*). These species are discussed in more detail below. The remaining animal species listed above are dismissed from further consideration because of a lack of more specific suitable habitat components or because they have not been located on more suitable habitat in other areas of the Laboratory.

The Northern Goshawk is found in dense, mature, or old growth coniferous forest. The highest percentage of nests in Los Alamos County are located in ponderosa pine/gambel oak, ponderosa pine/gray oak and mixed conifer (*Pinus ponderosa/Quercus Gambelii, Pinus ponderosa/Quercus grisea, and mixed conifer*) habitat types. (Kennedy, 1987). All of the above habitat types are represented in the OU. Travis (1992) reports observations of possible breeding pairs in TA-15, and a pair is known to nest in the northwest quadrant of LANL. A comprehensive survey for the Northern Goshawk was begun in June 1993. The following measures must be taken to avoid adverse impacts to Goshawks:

1. Any machine sampling occurring between May and October must be cleared through BRET. BRET must conduct a Goshawk survey 60 days prior to sampling to evaluate possible nest sites in and around the specific sampling area.

2. If any area over 0.1 acre will be disturbed, BRET must be contacted to conduct a pre-sampling site specific survey.

3. Any tree removal (live or snag) must be approved by BRET.

The spotted bat (*Euderma maculatum*) is found near standing water in riparian, piñon-juniper, ponderosa pine, and spruce-fir areas. Its two critical requirements are a source of water and the presence of caves in cliffs or rock crevices) for nesting. Some required habitat components for this species are present in the project area, including standing water in Pajarito Canyon. Mist-netting for spotted bats were conducted at a pond in TA-16, and in other areas on LANL lands. However, no spotted bats were captured in any of these surveys. Further surveys will be necessary to confirm the presence or absence of this far-ranging species in Los Alamos County. Although no sampling is projected to take place within the canyons during this phase of sampling, and the sampling that is proposed for the canyon rims should not affect sensitive habitat, the following measures must be taken to avoid adverse impacts to the spotted bat:

1. BRET must be notified prior to any proposed activities that would impact the slopes of the canyons surrounding OU 1085

2. No equipment larger than hand augers is scheduled to be used on canyon slopes in this OU. However, if any heavy equipment sampling should be necessary within the canyons, a biologist from EM-8 must be present prior to sampling to conduct a survey of all rock crevices in the sampling area. If any evidence of bats is found in the sampling area, all sampling with heavy equipment will be canceled.

3. BRET must approve any sampling that may alter an existing water source prior to any disturbance of that source.

The Mexican Spotted Owl (*Strix occidentalis lucida*) inhabits forested mountains and canyons (US Fish and Wildlife Review, 1990). Its habitat is primarily uneven-aged, multistory forest with closed canopies. Pajarito Mesa is not characterized by closed canopies and our transects have an average canopy cover of only 26.9%. However, in May 1993, T. Johnson, a state raptor specialist, began a survey for Mexican Spotted Oowls in Twomile and Pajarito Canyons. The survey suggests potential habitat for the owl in the canyons adjacent to the OU. Mitigation measures followed for the Northern Goshawk also apply to protection of the owl's habitat and foraging area.

1. No equipment larger than hand augers is scheduled to be used in and around canyons in this OU. However, if any heavy equipment sampling should be necessary, sampling occurring between May and October within Pajarito or Twomile Canyons or on Pajarito or Twomile Mesas within 400 m of the Canyons must be cleared through BRET. BRET must conduct a Mexican Spotted Owl survey 60 days prior to sampling to evaluate possible nest sites in and around the specific sampling area.

2. If any area over 0.1 acre will be disturbed, BRET must be contacted to conduct a pre-sampling site specific survey.

3. Any tree removal within Pajarito or Twomile Canyons, or on Pajarito or Twomile Mesas within 400 m of the canyons must first be cleared with BRET.

A.5.1 Wetlands/Flood Plains

Both wetlands and floodplains exist in the canyons surrounding the OU. The wetlands in Pajarito Canyon are paludal and temporarily flooded. Floodplain maps developed by McLin (1992) indicate that floodplains exist within Water, Threemile, and Pajarito Canyons, and in Cañon de Valle. One area in Pajarito Canyon along the northern border of TA-67 has been classified by the National Wetland Inventory as palustrine and temporarily flooded. No outfalls have been identified for OU 1085; however, there is some output from the leach field. No sampling is projected to take place within the floodplains or in the wetland in Pajarito Canyon. However, if any sampling takes place within floodplains or wetlands in the OU, in compliance with 10 CFR 1022, a Floodplain/Wetland Involvement Notification will be submitted to the Federal Register for public comment. RFI activities are not anticipated to adversely affect the floodplains and wetlands within OU 1085 as long as best management practices are adhered to.

A.6.1 Description of the Biological Environment

The vegetation surveys conducted during 1992 and 1993 indicated primarily three vegetation communities within and adjacent to Pajarito Mesa where the majority of the sampling is projected to take place: the Rocky Mountain montane conifer forest, the Great Basin conifer woodland and the Rocky Mountain riparian-deciduous forest communities. More specifically, much of the vegetation within the area lies within the piñon-juniper, ponderosa pine-juniper, ponderosa pine, and mixed conifer series.

BRET conducted five biological assessment surveys in TA-14 and 10 in TA-67. These surved areas were located on Pajarito Mesa, on north-facing slopes, south-facing slopes, canyon bottoms, and the riparian area of the OU. Most of the soil sampling scheduled for OU 1085 will take place on the mesa top, with several hand-auger surveys near the rim of Cañon de Valle. Some sampling will take place in a drainage ditch. This latter sampling could include a Threemile Canyon slope.

We read six transects along the top of Pajarito Mesa. The dominant overstory species were ponderosa pine, piñon pine, and one-seed juniper, with some mixed conifer along the north-facing rim of Pajarito Canyon. The shrub layer was dominated by species of oak, (wavyleaf, Gambel, and hybrid) with mountain mahogany, squawbush, and cliff rose. In some areas, the oaks, usually considered shrub, were large enough to be included as overstory. The dominant grasses on the mesa top were blue grama, mountain muhly, galleta, and big bluestem. Dominant forbs included wormwood, bitterweed, prickly pear cactus, snakeweed, and King's lupine. This diversity is surprising since transects 1 and 2 were located physically near to one another, as were transects 4 and 9.

Surface sampling is projected to take place within a drainage in OU 1186. BRET conducted three surveys in the drainage that is the head of Threemile Canyon: two in the canyon bottom and one on the south-facing slope. This area was characterized by an overstory of ponderosa pine and oak species, together with one-seed juniper. Dominant shrub species in the drainage bottom were mountain mahogany with New Mexico locust, cliff bush, and wax current, and the dominant shrub species on the south-facing slope was mountain mahogany. No transects were conducted on the north-facing slope of the drainage.

Hand-auger sampling is projected to occur near the south-facing slope of Cañon de Valle and on or near the south-facing slope of Threemile Canyon. Information from transects done on the south-facing slope of Cañon de Valle in OU 1082 can be extrapolated to the biological environment of the south-facing slope of Cañon de Valle in OU 1085.

Unburned south-facing slopes in OU 1082 can be characterized as ponderosa pine/one-seed juniper habitat type, with three tree overstory species: ponderosa pine (57%), Gambel oak (26%), and one-seed juniper (13%). Shrub species found on the transect were Gambel oak (68%), New Mexico locust (5%), cliffbush (5%), and mountain mahogany (4%). The remaining 18% is an unidentified oak species, probably more Gambel oak or wavyleaf oak. The dominant understory species in the transect include little bluestem (35%), mountain muhly (26%), and wormwood (12%), together with other common species such as bluegrass, big bluestem, and nodding brome.

BRET surveyed south-facing transects at two locations in upper Threemile Canyon. Ponderosa pine dominated one site while piñon pine dominated the other. One-seed juniper was present in both transects but only at low densities. These transects had the lowest numbers of trees per acre and very low percentage cover values (9.93 and 13.10).

A.7.1 Best Management Practices

Impacts to nonsensitive plants should be avoided when possible. Off-road driving is especially harmful to plants and soil crust. Vehicular travel should be restricted to existing roads whenever possible. If off-road travel is required, EM-8 should be contacted to monitor the activity. Revegetation may be required at some sites. A list of native plants suitable for revegetation for OU 1085 will be contained in the final report "Biological Assessment Restoration Program, OU 1085."

Several raptors breed in the OU and Travis (1992) reports one confirmed nest and a probable nesting site for the Red-tailed Hawk (*Buteo jamaicensis*), and substantiated observations of breeding pairs of the American Kestrel (*Falco sparverius*) and Great Horned Owl (*Bubo virginianus*). The Northern Pygmy-Owl (*Glaucidium gnoma*) is a possible breeder in the OU, and the Turkey Vulture (*Cathartes aura*), Sharp-shinned Hawk (*Accipiter striatus*), and Flammulated Owl (*Otus flammeolus*) utilize the area for foraging. Potential raptor nest sites and roosts occur in ponderosa pine and mixed conifer forest, and the steep cliffs with small caves and rock crevices found in the OU also provide the seclusion and commanding views required for nesting and roosting (Travis, 1992). From March to September, nesting sites should not be exposed to additional noise, heavy equipment, and activities that could adversely impact the raptors' mating, nesting, foraging, and raising young. BRET should be contacted 60 days prior to sampling to identify potential nesting sites before beginning such activities.

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APPENDIX B

LIST OF CONTRIBUTORS

NAME AND AFFILIATION	EDUCATION/EXPERTISE	ER PROGRAM ASSIGNMENT
Scott Kinkead	Ph.D. Inorganic Chemistry 10 years experience in actinides chemistry, 1 year work in environmental restoration, 10 years experience in high explosives, energetic material, and propellants.	Operable Unit 1085 Project Leader
Caroline Mason	Ph.D. Inorganic Chemistry 19 years experience at Los Alamos in hydrogen energy research and in international scientific developments, including environmental issues abroad.	Operable Unit 1106 Project Leader
Susan Alexander (HS-5)	B.A. Environmental Health 6 years experience in industrial hygiene; 3 years experience in hazardous waste; occupational health and safety	Health and Safety Project Plan
Jan Beck (Radian Corp.)	B.A. Biology 4 years experience in environmental risk assessment	Work plan support
Paul Black (Neptune and Co., Inc.)	M.S. Statistics (Ph.D. expected in December 1993) 12 years experience in survey design, Bayesian statistics, and data quality objectives (DQOs)	Technical review, development of DQOs
Margaret Burgess (IS-1)	B.A. English 10 years experience as a technical writer/editor, 3 years experience environmental restoration documents	Technical writer/editor
Dow Davidson (EES-4)	B.A. Anthropology 15 years experience in quality assurance/sample management	Development and incorporation of sampling plans
Pete Encinias (MST-3)	Associate of Science in Science B.S. Environmental Science due 5/94, 10 years medical technician, 4 years R&D in laser Raman spectroscopy, 1 year experience in ER work	Liaison with M-Division, technical review
Terry Foxx (EM-8)	M.S. Environmental Science, B.S. Biology 3 years experience in performing biological field studies under ER and other programs	Baseline data for ecological risk and natural resource damage assessments
Calvin Martel	Ph.D. Chemistry Numerous years experience in chemistry in the Los Alamos Laboratory.	Operable Unit 1085 Project Leader (Retired)

NAME AND AFFILIATION	EDUCATION/EXPERTISE	ER PROGRAM ASSIGNMENT
Wayne Hansen (EES-15)	Ph.D. Radiation Biology 23 years experience in risk analysis for environmental hazards from radionuclides and chemicals	Ecological Risk Technical Team Leader
Betty W. Harris (M-1)	Ph.D. Chemistry 15 years experience in explosive chemistry R&D for M Division, 2 years experience doing ER work dealing with HE-contaminated facilities	Chemist
Don Hickmott (EES-1)	Ph.D. Geochemistry 6 years experience in aqueous and environmental geochemistry	Geology
Dorothy Hoard (CLS-1)	B.A. Biochemistry 18 years experience in analytical chemistry, published author	Archival research, technical review
Andrea Kron (cARTography by Andrea Kron)	B.A. Geology 18 years experience in cartography, geology, and technical illustration	Illustrations, flow charts, and tables
Beverly Larson (EM-8)	M.A., B.A. Anthropology 19 years experience in cultural resource management	Archeology team leader
Deborah Magid (Ray Rashkin Associates)	8 years editing experience, 13 years experience in desktop publishing	Technical editor/ compositor
Dave McInroy (EM-13)	B.S. Biology 9 years experience in waste management activities, including project management	Programmatic Project Leader, Regulatory Compliance
Dean Neptune (Neptune and Co., Inc.)	Ph.D. Physiology and Biochemistry 27 years experience in planning, implementation, and assessment of environmental measures used in decision making	QA/QC and development of data quality objectives (DQOs)
Eugene Potter (The Delphi Groupe/ HS-12)	M.S. Nuclear Engineering Certified Health Physicist, 15 years experience in operational health physics and radiological risk assessment	Risk assessment technical team member
Ken Uher (M-1)	10 years experience in explosives testing	Firing site supervisor, TA-14
Steve Watanabe (CLS-DO)	B.S. Business Administration 1 year experience as Deputy OUPL for OU 1085, computer archivist	Deputy OUPL, archival research, technical review

Beverly Dickinson CST-10	21 years office management and word processing.	Coordination, work plan preparation
Virginia Cleary, IS-1	B.A. Zoology 24 years experience in technical editing.	Technical Editor

APPENDIX C

GENERAL INFORMATION ABOUT EXPLOSIVES USED AT TA-12 AND TA-14

APPENDIX C GENERAL INFORMATION ABOUT EXPLOSIVES USED AT TA-12 AND TA-14

C.0 INTRODUCTION

Since their inception in about 1944, TA-12 (L-Site) and TA-14 (Q-Site) have been areas at which explosives and mixed explosive compositions have been test fired. Both sites are large, isolated land masses well suited for firing activities. Beginning in 1944, most of the research and development on energetic materials, done as part of the Manhattan Project, were performed by the Explosives (X) Division. At the height of the research, thousands of pounds of explosives were used each month. Many of these were engineered into explosives lenses, but others took different configurations (Rhodes 1886, 0664; Hawkins et al. 1983, 0850). Scrap explosives and explosive-contaminated materials such as rags and paper were either burned or destroyed by detonation (Department of the Army 1984, 1109). Thus, explosives and co-ingredients associated with their formulation, used and disposed of by detonation, are major contaminants in the soil at TA-12 and TA-14.

A minor but significant portion of the contamination comes from the initiating devices, detonators, and from fuel oil used in burning operations. Polynuclear aromatic hydrocarbons (PAHs), explosives, beryllium, uranium, and barium have been reported in soil samples taken from TA-14 and probably exist in the soil at TA-12 (LANL 1989, 0425).

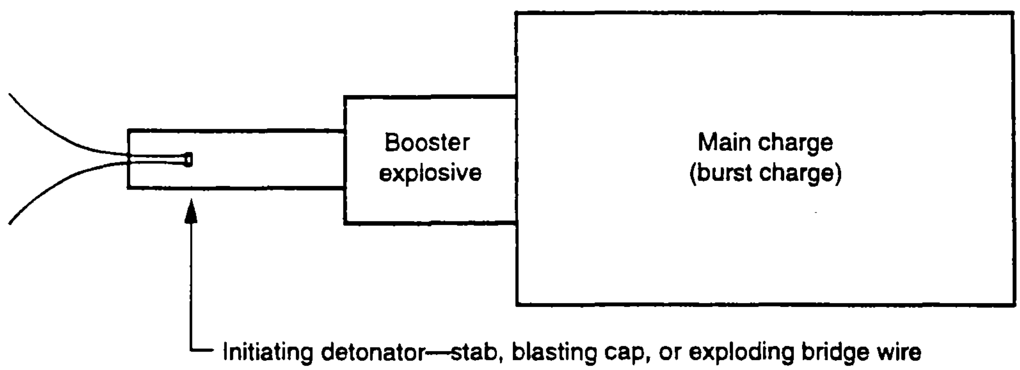
This appendix looks at the characteristics of the pure and formulated explosives fired at TA-12 and TA-14; possible effects of metal contamination; and the PAHs detected in some burning grounds.

C.1 Explosive Package of a Weapon System

The explosive package of a weapon system consist of an initiator, a booster, and a burst (main) charge (Figure C-1). The type of explosive used for each component in the explosive train depends upon the physical and chemical characteristic of the energetic material. Formulated explosive mixtures may have different characteristics and a different classification from the pure material.

C.2 Types of Explosives in Laboratory Weapon Systems

Explosives are classified based upon their sensitivity, such as primary or initiating explosives and secondary (booster or main charge) explosives. Also, the designations, sensitive and insensitive, are descriptive and meaningful for workers in the industry. Explosives may be classified according


Booster
explosive
Main charge
(burst charge)
Initiating detonator—stab, blasting cap, or exploding bridge wire

to the amount of potential (thermal) energy they possess or their ability to sustain a detonation wave: thus, high-energy explosives, high explosives (HE), or low-energy explosives. However, there is no known universal number for the thermal energy or the detonation velocity that would distinguish a borderline HE from a low-energy explosive. A working value of 500 meters per second (m/s) is acceptable among US scientists. Both classifications, secondary and HE, are used interchangeably in the industry (Department of the Army 1984, 1109). A more recent category of energetic material is the insensitive high-energy explosive (IHE).

C.3 Primary Explosives

Primary (initiating) explosives are energetic materials that are unstable and extremely sensitive to impact, sparks, heat, and many other outside influences. They are often used as initiators or in initiating devices such as detonators. Lead azide, mercury fulminate, and lead styphnate are examples of primary explosives (Table C-1).

C.4 Low-Energy Explosives

Low-energy explosives, such as black powder or smokeless powder, will undergo autocombustion (oxidation) reactions or decompositions at a rate that varies from a few centimeters per second to approximately 4.0 Km/s. They may be mixtures of more than one ingredient (Table C-2). Black powder is a mixture of either potassium or sodium nitrate, charcoal, and sulfur (6:1:1 wt %).

C.5 Secondary Explosives

Secondary explosives compose another group of compounds that includes 2,4,6-trinitrotoluene (TNT) and nitroglycerine (NG). They have been found to sustain detonation reactions at rates from 1.0 to 8.5 Km/s. Such materials are known as high-energy explosives or HE (Table C-3). They are several magnitudes more stable and less sensitive to external physical factors than primary explosives. Properties of some secondary explosives are given in Table C-4. The secondary explosive can be an IHE such as TATB. Initiating explosives are generally required to "set off" or cause a reaction in secondary explosives. There is no known universal agreed-upon value for the detonation velocity or thermal energy that would distinguish the HE from the non-HE material or low-energy materials. A working value of 5.0 Km/s is used by US scientists.

Secondary explosives may be used as boosters or as main charges in the weapons explosive package, which is similar in design to the initiating device (Figure C-1). They may be pure explosives, thermal-cast mixtures, or plastic bonded mixtures (PBXs). Thus, single compounds such as TNT, NG, hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX, cyclotrimethylene-trinitramine), 1,3,5,7-tetranitro-1,3,5,7-tetrazacycle-octane (HMX, cyclotetramethylenetetranitramine) nitroguanidine (NQ), 1,3,5-triamino-2,4,6-trinitrobenzene (TATB), and others that would sustain a detonation wave of 5.0 Km/s or greater would be considered high explosives (Tables C-3, C-4, and C-5). In addition, TATB would be better classified as an IHE, which means that it is several magnitudes more stable than most secondary explosives.

TABLE C-1

PRIMARY OR INITIATING EXPLOSIVES

NAME	FORMULA	YEAR DISCOVERED	YEAR FIRST COMMONLY USED
Mercury fulminate	$C_2N_2O_2Hg$	~1700	1867
Lead azide	PbN_6	~1880	~1904
Lead styphnate hydrate	$C_6H_3N_3O_9Pb$	~1914	~1920
Diazodinitrophenol (DDNP)	$C_6H_2N_2O_5$	1860	1928
Lead dinitroresorcinate (LNPR)	$PbC_6H_2N_2O_6$	1882	~1925

TABLE C-2

LOW-ENERGY MIXED EXPLOSIVES

DESIGNATION	COMPOSITION (wt %)	NOMINAL WORKING DENSITY (g/cm^3)	DETONATION VELOCITY (Km/sec)	DETONATION PRESSURE (kbars)	CONSISTENCY
Dynamite					
Straight	50 NG/0.2 NC/34 SN/15.8 C	1.4	~5.8	~100	Powder
Ammonium	16 NG/0.1 NC/78.7 AN/6 F	1.3	~4.8		Powder
Ammonium gel	26 NG/0.6 NC/34 AN/28 SN/11.4 C	1.3	~5.4		Gel
ANFO	94 AN/6 FO	~0.8	~4.7	~40	Powder
Slurry and Gel					
SE-TNT	TNT/AN/SN/W/G			~100	Slurry or gel
SE-TNT/Al	39 AN-SN/20 TNT/25 Al/15 W/1 G	1.60	~3.5		Slurry or gel
SBA/Al	49 AN-SN/35 Al/15 W/1 G	1.45	<4.0	60	Slurry or gel

TABLE C-3

MORE COMMON SINGLE COMPOUND HIGH EXPLOSIVES

MATERIAL	SYMBOL	FORMULA	YEAR	
			DISCOVERED	FIRST COMMONLY USED
Ammonium nitrate	AN	$H_4N_2O_3$	1659	1867
Nitroglycerine	NG	$C_3H_5N_3O_9$	1847	1867
1,3,5-Trinitrotoluene	TNT	$C_7H_5N_3O_6$	1863	1901
Pentaerythritoltetranitrate	PETN	$C_5H_8N_4O_{12}$	1894	~1929
Cyclotrimethylenetrinitramine	RDX	$C_3H_6N_6O_6$	1899	~1940
Cyclotetramethylenetetranitramine	HMX	$C_4H_8N_8O_6$	~1940	~1950
Nitroguanidine	NQ	$CH_4N_4O_2$	1877	~1901
Triaminotrinitrobenzene	TATB	$C_6H_6N_6O_6$	1888	~1960

TABLE C-4

BASIC PROPERTIES OF COMMON SINGLE-COMPOUND HIGH EXPLOSIVES

MATERIAL	STATE	M. P. (°C)	COLOR	DENSITY (g/cm^3)	DETONATION VELOCITY (Km/sec)	DETONATION PRESSURE (kbars)
AN	Solid	170	White	1.75	—	—
NG	Liquid	13	Clear	1.60 at 20°C	7.580	~230
TNT	Solid	80	Yellow	1.65	6.930	190
PETN	Solid	140	White	1.70	7.980	300
RDX	Solid	204	White	1.80	8.750	347
HMX (b)	Solid	285	White	1.90	~9.100	393
NQ	Solid	~250	White	1.75	8.400	~260
TATB	Solid	>450	Yellow	1.90	~7.600	275
Explosive D	Solid		Yellow			

TABLE C-5

HIGH-ENERGY MIXED EXPLOSIVES

DESIGNATION	COMPOSITION (wt %)	NOMINAL WORKING DENSITY (g/cm^3)	DETONATION VELOCITY (Km/sec)	DETONATION PRESSURE (kbars)	CONSISTENCY
Plastic or Wax Bonded Mixtures					
Composition C-4	91 RDX/2.1 rubber/1.6 oil/5.3 plasticizer	1.0 to 1.6	8.0	255	Plastic
Sheet explosive	60-85 PETN/0-8 NC/rubber and plasticizer	~1.5	~7.0	185	Rubbery sheets
PB-HMX or RDX	80-95 RDX or HMX/ 20-5 various plastics or plastic and plasticizers	1.6 to 1.85	7.0 to 8.5	<275 to 375	Solid
Composition A	90 RDX/10wax	1.6	8.1	260	Solid
TNT Mixtures					
Ammatol	50 TNT/50 AN	1.55	6.3	—	Solid
Composition B	40 TNT/60 RDX	1.70	7.9	285	Solid
Cyclotol 75/25	25 TNT/75 RDX	1.75	8.2	320	Solid
Octol 75/25	25 TNT/75 HMX	1.82	8.4	340	Solid
Pentolite 50/50	50 TNT/50 PETN	1.67	7.4	245	Solid
Tritonal	80 TNT/20 Al	1.72	6.7	—	Solid

The energetic materials fired, burned, or disposed of at TA-12 and TA-14 were generally secondary explosives/HE. In 1944 through 1952, most of these were cast mixtures of TNT and other materials. Examples are torpex, pentolite, baratol, boracitol, and composition B.

The detonators used were based on pentaerythrite tetranitrate (PETN). These low-energy detonators are typical electric blasting caps referred to as exploding bridgewire detonators (Figure C-2).

C.5.1 Composition B

In 1945 Composition B, which had proven to be approximately 40% more powerful than TNT, was used extensively in weapons research. It was poured as a hot slurry of wax, molten TNT, and a noncrystalline powder RDX. The composition is approximately 60% RDX and 40% TNT. During World War II, HMX existed as an impurity in RDX which was not removed before formulation.

C.5.2 Baratol

Baratol was used frequently as the slow-burning component of weapons systems. Its formulation is a slurred barium nitrate, aluminum powder, TNT mixture that contains stearoxyacetic acid and nitrocellulose. Approximate composition is 76% barium nitrate and 24% TNT.

C.5.3 Pentolite

PETN was standardized during World War II. An equal weight mixture of PETN with TNT became known as pentolite. It was used as a burst (main) charge for grenades and as a booster-surround charge for weapons applications.

C.5.4 Torpex

This TNT composition was also standardized during World War II and used in bombs. It is 41% RDX, 41% TNT, and 18% aluminum. It is noted for its great blast effect.

C.5.5 Boracitol

Boracitol is another heavily used mixed explosive. It contains 60% boric acid and 40% TNT.

C.6 Mock HE

Mock HE is a compound used to simulate HE for engineering purposes and for the accumulation of test data. Cyanuric acid was a commonly used mock HE.

Figure C-2

C.7 Igniters and Detonators

There are two types of devices that are used to make an energetic material react; they are igniters and detonators. Igniters convey a flame to the explosive, causing it to burn, while detonators transmit, through a primary explosive, a sharp blow (shock) that causes the secondary explosive to disassociate, detonate, or burn with extreme rapidity (Harris 1987, 21-0055). The Laboratory used electric blasting cap detonators (exploding bridge wire) to initiate their devices (Figure D-2). Large volumes of detonators were used and destroyed at TA-12 and TA-14. PETN is the explosive component of those devices.

C.8 CONTAMINANTS OF CONCERN FROM EXPLOSIVES

Contaminants of concern from operations involving explosives at TA-12 and TA-14 are residual parent explosives and impurities, inorganic, metals, PAHs, nitroaromatics, partial detonation products, biodegradation products, and radionuclides such as uranium. Parent explosives include TNT, RDX, HMX, PETN, and possibly tetryl. Inorganic are nitrates, nitrites, and carbonates. Metals of concern are those found in weapon components and in bullet casings, Pb, Ba, Cr, Cd, and Hg. Derivatives of naphthalene, anthracene, benzopyrene, and fluoranthene, often referred to as PAHs, are found in burning ground soil. Some of these are carcinogens. Major impurities and degradation products from explosives are 2,4-dinitrotoluene (2,4-DNT), 2,6-Dinitrotoluene (2,6-DNT), 1,3,5-Trinitrobenzene (TNB), 1,3-Dinitrobenzene (1,3-DNB), and nitrates. A more complete listing of possible contaminants is iterated in Table C-6, but many of these have not been found in the soil at HE facilities. Many of the partial detonation products have not been identified nor characterized sufficiently.

TABLE C-6

EXPLOSIVE CONSTITUENTS OF POTENTIAL CONCERN IN THE ENVIRONMENT

PRINCIPAL TYPE OF EXPLOSIVE	PARENT EXPLOSIVE (production impurities)	PRODUCTS OF INCOMPLETE DETONATION AND/OR PRODUCTS OF INCOMPLETE COMBUSTION	PRODUCTS OF ENVIRONMENTAL DEGRADATION	CONSTITUENTS DETECTED IN THE ENVIRONMENT
HMX	RDX, aliphatic and cyclic nitro-compounds (a)	Barium, lead, friable asbestos, PAHs (b)	Nitrate ions, nitrite ions, ammonia, formaldehyde, organic nitro-compounds, hydrogen cyanide (a), mono-, di-, and trinitroso-RDX analogues, hydrazine, 1,1-dimethylhydrazine, 1,2-dimethylhydrazine, methanol (a)	Parent explosive (HMX, RDX, aliphatic and cyclic nitro-compounds), inorganics, metals, products of incomplete detonation and products of incomplete combustion (lead, friable asbestos, PAHs) (a)
RDX	HMX, aliphatic and cyclic nitro-compounds (a)	Barium, lead, friable asbestos, PAHs (b)	Similar to those of HMX (a)	Parent explosive (RDX, HMX, aliphatic and cyclic nitro-compounds), inorganics, metals, products of incomplete detonation and products of incomplete combustion (lead, friable asbestos, PAHs) (a)
TNT	2,4-DNT, 2,6-DNT, 1,3-DNB, 1,3,5-TNB (a)	Barium, TNT, 2,4-DNT, 2,6-DNT, 1,3,5-TNB, 1,3-DNB, lead, friable asbestos, PAHs (b)	1,3,5-TNB, TNBOH, TNBAL, TNBA, anthranils (e.g., 2,6-dinitroanthranil), nitriles (e.g., 2,4,6-trinitrobenzonitrile), amines (2-amino-4,6-DNT, 4-amino-2,6-DNT, 3,5-dinitrophenol, 2-amino-4,6-dinitrobenzoic acid) (a)	Parent explosive (TNT, 2,4-DNT, 2,6-DNT, 1,3-DNB, 1,3,5-TNB), inorganics, metals, products of incomplete detonation and products of incomplete combustion (lead, friable asbestos, PAHs), environmental degradation products (2-amino-4,6-DNT, 4-amino-2,6-DNT) (a)
PETN	PE-tri-N, dipentaerythritol hexanitrate, tripentaerythritol acetonitrate (a)	Lead, friable asbestos, PAHs (b)	Pentaerythritol (PE or Pe-tri-N) (a)	Parent explosive, inorganics, metals, products of incomplete detonation and products of incomplete combustion (lead, friable asbestos, PAHs), environmental degradation products (a)
Tetryl	No production impurities of consequence (a)	Lead, friable asbestos, PAHs (b)	N-methylpicramide, picric acid, methylnitramine (a)	Parent explosive, inorganics, metals, products of incomplete detonation and Products of incomplete combustion (lead, friable asbestos PAHs) (a)

Legend:

2-amino-4,6-DNT 2-amino-4,6-dinitrotoluene
4-amino-2,6-DNT 4-amino-2,6-dinitrotoluene
1,3-DNB 1,3-dinitrobenzene
2,4-DNT 2,4-dinitrotoluene
2,6-DNT 2,6-dinitrotoluene
1,3,5-TNB 1,3,5-trinitrobenzene
HMX cyclotetramethylenetetranitramine
PE-tri-N pentaerythritol
PETN pentaerythritol tetranitrate
PAH polycyclic aromatic hydrocarbon
RDX cyclonitrite, cyclortrimethylenetrinitramine
TNBA 2,4,6-trinitrobenzoic acid
TNBAL 2,4,6-trinitrobenzaldehyde
TNBOH 2,4,6-trinitrobenzyl alcohol
TNT 2,4,6-trinitrotoluene

Footnotes:

(a) Layton et al 1987, 15-16-447
(b) USATHMA 1986, 15-16-457

C.8.1 Cyanuric Acid (Mock HE)

As a pure compound, cyanuric acid poses few hazards to humans; however, it will react violently with ethanol and acetonitrile. Upon decomposition, hydrogen cyanide (HCN) can be formed. Under the proper conditions, the cyanide radical will biodegrade to harmless materials such as ammonia, nitrates, and/or gaseous nitrogen. Mock HE was fired at both TA-12 and TA-14.

C.8.2 Polynuclear Aromatic Hydrocarbons (PAHs)

PAHs are produced when organic materials such as fuel oils are burned at temperatures above 500°C. Both 3,4-benzopyrene and 3,4-benzofluoranthene are included in the products from incineration, and both are carcinogenic to animals. Some of the metabolites of PAHs are known to cause cancer. The most studied is 7,8-diol-9,10-epoxide, a metabolite of benzo(a)pyrene; it has two steroisomers that are potent mutagens (Manahan 1989, 1112). In the past, when scrap/waste explosives and explosive-contaminated materials were disposed of by incineration, excelsior (wood product) and fuel oil were a part of the process. Therefore, PAHs present in fuel oil become a part of the soil at burning grounds and have been identified in TA-14 soil samples. PAHs are not rapidly broken down by the microbes in the soil and could remain for a number of years.

The manner in which individual PAHs behave in the soil is linked directly to the molecular weight of each PAH. Research has shown that the higher the molecular weight the less volatile the PAH. Therefore, less volatile compounds would remain in the soil for a longer period of time (Clement International Corporation 1990, 0873). In addition, sorption of the PAHs to the soil is dependent upon the soil type. Soils rich in organic matter tend to bind the high molecular weight PAHs, more strongly to their surfaces than low molecular weight PAHs, with water partition coefficient, K_{OC}, values of 10^{+5} to 10^{+6}. These strongly-bound compounds will be transported in water absorbed onto particulate whereas low molecular weight PAHs will volatilize. Again, PAHs are not degraded by microbes to any great extent in water nor in soil.

C.8.3 Metals

The concentrations of several metals in the soil at TA-12 and TA-14 are increased as a result of past and present firing activities. Moisture content and soil pH are important factors in determining the mobility of the unbound metal, which are generally more mobile in acidic media. Lead is an exception, as it is mobile under both acidic and basic media. Some metals can have adverse health effects if ingested or absorbed into the body at significantly high concentrations (The Handbook of Chemistry and Physics; The Handbook on Toxic and Inorganic Compounds; Hazardous and Toxic Effects of Industrial Chemicals).

C.8.3.1 Lead (Pb)

Lead can be found in nearly all parts of OU 1085. Lead used in bullets tested at TA-14 typically is an alloy containing 8-12% antimony and up to 0.25% tin to increase hardness.

The presence of lead and lead compounds in the environment does not necessarily result in exposure to the workers. The lead must be inhaled, ingested, or absorbed through the skin in measurable quantities to cause an exposure.

When lead is inhaled, it is easily absorbed from the respiratory tract and symptoms of lead poisoning tend to develop immediately, whereas most of the ingested lead passes through the body and is eliminated in the feces. Absorbed lead is caught in the liver and excreted, in part, through the bile. Absorption of organic lead compounds through the skin is more effective in causing lead poisoning than the absorption of inorganic compounds.

C.8.3.2 Barium (Ba)

Barium nitrate is a compound used in explosive formulation and has become a significant contaminant in the environment at weapon facilities. Its toxic effect to humans and the environment is low but still of concern.

C.8.3.3 Beryllium (Be)

Beryllium was used extensively in weapons designs during World War II. Beryllium and its salts are highly toxic and the soil contaminated with this metal should be handled with the greatest of care. Entrance into the body is by inhalation.

C.8.3.4 Chromium (Cr)

Chromium is a toxic metal. Its routes of entry are percutaneous absorption, inhalation, and ingestion. Chromium compounds in the +3 oxidation state are of low order of toxicity. In the +6 oxidation state, chromium compounds are irritants and corrosive.

C.8.3.5 Uranium (U)

Uranium is a radioactive, toxic, heavy, silvery- white, malleable, ductile metal softer than stainless steel. It is also a carcinogen. Natural uranium consists of 238-U and 234-U in radioactive equilibrium, plus 0.7% of 235-U. Enriched uranium has an increased percentage of the lighter isotopes, 234-U and 235-U: its specific activity and its radiation hazards are correspondingly increased.

Isotope 235 U decays to radioactive thorium (231-Th) via 4.3 to 4.6 MeV alpha particles. Isotope 238-U decays to radioactive 234-Th via 4.2 MeV alpha particles.

C.9 FATE AND TRANSPORT OF EXPLOSIVES AND EXPLOSIVES BY-PRODUCTS

In addition to environmental degradation, other factors affect the potential fate and migration of PCOCs in the environment. These include the physical and chemical properties of the constituents and their degradation products as well as the physical and geochemical characteristics of the sediments and soils on site. Factors such as soil pH, soil cation-exchange-capacity (CEC), water infiltration rate, soil porosity, along with chemical-specific factors [e.g., octanol water partition coefficient (K_{OC}), and soil retention factors (K_d)] are key to understanding the potential migration patterns of these constituents. A summary of aspects of the environmental fate of explosives is presented in Table C-7.

Layton et al. (1987, 15-16-447) provide a detailed discussion of the distribution of HE in environmental media. They calculate the distribution of a number of HE, including TNT, HMX, RDX, and HE by-products including DNT and DNB, in reference landscapes using the program GEOTOX. They also summarize existing data confirming HE and HE by-products at open burn/open detonation sites nationwide.

The most important result of the modeling is that all of the HE and HE by-products are calculated to be distributed into both surface soils (A soil horizons) and subsurface soils (B soil horizons). In the western ecoregion models TNT, DNT, and RDX were all predicted to favor subsurface over surface soils. This modeling may not be directly relevant to TA-12 and TA-14 because a near-surface groundwater reservoir was included in the models.

The compiled data on concentrations of HE and HE by-products for a wide variety of facilities also suggest that HE is distributed in surface and subsurface soils (Layton et al. 1987, 15-16-447). In general, the actual field data suggest greater concentrations of HE in surface soils than predicted by the GEOTOX modeling.

The implication of these data for TA-12 and TA-14 is that subsurface sampling for HE will be necessary at those sites where HE contamination is likely. However, the lack of evidence for decoupling of surface and subsurface HE suggests that surface screening can be used to locate subsurface HE contamination.

The Explosives, Testing, and Safety Group monitoring records show both surface and subsurface contamination of HE at TA-14 and surface chunks of HE at TA-12 firing areas (Haywood 1993, 21-0082).

Table C-7
Environmental Fate of Explosives and HE By-Products

CONSTITUENT OF POTENTIAL CONCERN	WATER SOLUBILITY (mg/L)	Log K_{OC}	HENRY'S CONSTANT (atm-m^3/mol)	ENVIRONMENTAL FATE	PRIMARY LOCATION IN ENVIRONMENT
2-amino-4,6-DNT	2 800 (a)	0.15 (a)	~4 E-9 (a)	Gradual movement through soils and groundwater, should bind to humic acids and other organic matter (a)	Subsurface soils and groundwater (a)
4-amino-2,6-DNT	2 800 (a)	0.26 (a)	~1 E-9 (a)	Gradual movement through soils and groundwater, should bind to humic acids and other organic matter (a)	Subsurface soils and groundwater (a)
1,3-DNB	533 (b)	1.56 (b)	1.8 E-7 (b)	Gradual movement through soils and groundwater (a)	Subsurface soils and groundwater (a)
2,4-DNT	280 (b)	2.4 (b)	1.86 E-7 (b)	Gradual movement through soils and groundwater, diffusion of both vapor and aqueous phases through soil in soils receiving limited water infiltration (a)	Subsurface soils and groundwater (a)
2,6-DNT	206 (b)	1.89 (b)	4.86 E-7 (b)	Gradual movement through soils and groundwater, diffusion of both vapor and aqueous phases through soil in soils receiving limited water infiltration (a)	Subsurface soils and groundwater (a)
HMX	2.6 (a) or 5.0 (a)	2.11 (a)	1 E-16 (a)	Leaching through soils	Subsurface soils and groundwater (a)
PETN	2 (a) or 32 (a)	1.83 (a)	4 E-10 (a)	Leaching through soils	Subsurface soils and groundwater (a)
PE-tri-N	Very soluble (a)	N/A	N/A	Very stable in sunlight, resistant to microbial degradation (a)	Subsurface soils and groundwater (a)
RDX	42.2 (a)	0.89 to 2.43 (a)	6.58 E-12 (a)	RDX does not strongly adsorb to soils and sediments, soil adsorption affects RDX migration only in soils with an organic content >0.25 wt % (a)	Subsurface soils and groundwater (a)
Tetryl	75 (a)	2.43 (a)	2.0 E-12 (a)	Leaching through soils (a)	Subsurface soils and groundwater (a)
1,3,5-TNB	385 (b)	2.82 (b)	9 E-8 (b)	Gradual movement through soils and groundwater (a)	Subsurface soils and groundwater (a)
TNT	123 (a)	2.67 to 3.2 (a)	2.6 E-9 (a)	Migration of TNT is affected in soils with a cation exchange capacity (CAC) >10 meg/100 g; vapor-phase diffusion only important in soils where water infiltration is low (a)	Subsurface soils and groundwater (a)

(a) Layton et al. 1987, 15-16-447
(b) Burrows et al. 1989, 15-16-455

C.10.0 TOXICITY OF HE CONSTITUENTS

Several of the explosives, co-constituents, degradation products of the explosives, and associated experimental materials are carcinogens and/or systemic toxicants. Nearly all of the potential contaminants may exert their toxic effect (i.e., either carcinogenic and/or systemic effect) through any of the direct routes of exposure (i.e., inhalation, incidental soil ingestion, ingestion of water, and dermal exposure). The exceptions to this include the carcinogenic metals (cadmium, chromium VI, and nickel) and the carcinogenic mineral asbestos, which are considered by the US Environmental Protection Agency (EPA) to be carcinogenic only through the inhalation route of exposure.

Table C-8 lists the potential inorganic contaminants considered by the EPA to be carcinogenic only through the inhalation route of exposure (EPA 1992, 0830). They are placed in order of highest carcinogenicity to lowest carcinogenicity. The class of carcinogen refers to the evidence used to support the carcinogenic classification. For example, the evidence supporting the carcinogenic classification of A for a potential contaminant is stronger than that for a constituent with a carcinogenic classification of B.

Table C-9 lists the potential inorganic and organic contaminants that are explosives' components considered by the EPA to be carcinogenic through all direct routes of exposure (EPA 1992, 0830). The target organs identified are for the oral route of exposure. These potential contaminants are placed in decreasing order of carcinogenicity within each class of chemical (i.e., inorganics and organics).

All of the aforementioned constituents have the potential to exert a systemic toxic effect through all direct routes of exposure. However, systemic health criteria have not been developed for all of these constituents. Tables C-10 and C-11 list the constituents, oral target organ designation, and oral reference criteria [i.e., reference dose (RfD) in mg/kg-day] available from the EPA. An RfD is the highest dose that an individual may receive throughout his lifetime without experiencing an adverse health effect. The more toxic systemic constituents have the lowest RfDs. These constituents are placed in decreasing order of systemic toxicity within each class of chemical (i.e., inorganics and organics).

The high-energy explosives used during the 1940s and 1950s were mixtures of TNT and RDX with other components playing a minor role. Later, HMX became available and was used in a mixture with TNT. Although plastic-bonded explosives were researched in the 1940s, they were not mass-produced until the 1950s (Layton 1987, 1060l; Rickert 1985, XXXX). The toxicity data herein should not be used without close scrutiny of the methods used and the results obtained.

Also, it is not feasible to extrapolate from bacteria or animals to humans, but one can use laboratory data as a warning tool in assessing potential hazards.

TABLE C-8
CARCINOGENIC INORGANICS VIA INHALATION – HE DEVICE CONSTITUENTS

CONSTITUENT	CLASS OF CARCINOGEN	TARGET ORGAN
Chromium (VI)	A	Lung
Cadmium	B1	Respiratory tract

TABLE C-9
CARCINOGENIC CONSTITUENTS VIA ALL ROUTES OF EXPOSURE – HE AND BY-PRODUCTS

CONSTITUENT	CLASS OF CARCINOGEN	TARGET ORGAN FOR ORAL ROUTE
Inorganics		
Beryllium	B2	Multiple organs
Organics		
PAHs (i.e., benzo[a]pyrene)	B2	Stomach
2,4-DNT	B2	Liver
2,6-DNT	B2	Liver
RDX	C	Liver
TNT	C	Bladder

TABLE C-10

ORGANIC SYSTEMIC TOXICS – HE AND BY-PRODUCTS

CONSTITUENT	ORAL RfD (mg/kg/day)	TARGET ORGAN OR EFFECT
1,3,5-TNB	5.00E-5	Spleen
1,3-DNB	1.0E-4	Spleen weight
Nitrobenzene	5.00E-4	Liver, kidney
2,4,6-TNT	5.00E-4	Liver
2,4-DNT	2.00E-3	Neurotoxic
RDX	3.00D-3	Prostate
Tetryl	1.00E-2	Liver, kidney, spleen
HMX	5.00E-2	Liver

TABLE C-11

INORGANIC SYSTEMIC TOXICS – HE DEVICE COMPONENTS

CONSTITUENT	ORAL RfD (mg/kg/day)	TARGET ORGAN OR EFFECT
Lead	10 ug/dl (blood) [a]	Central nervous system
Cadmium	5.00E-4	Kidney
Uranium	3.00E-3	Kidney
Beryllium	5.00E-3	Not available
Chromium VI	5.00E-3	Central nervous system
Vanadium	7.00E-3	Not available
Cyanide	2.00E-2	Myelin degradation
Nickel	2.00E-2	Decreased body weight
Barium	7.00E-2	Blood pressure
Boron	9.00E-2	Testicular effects
Manganese	1.00E-1	Central nervous system
Nitrite	1.00E-1	Methemoglobemia
Zinc	2.00E-1	Anemia
Copper	1.30E+0	GI irritation
Nitrate	1.60E+0	Methemoglobemia

[a] The blood lead level of 10 ug/dl has been selected as a cutoff for intervention. Lead does not have an RfD because lead does not have a known threshold for the induction of systemic effects (EPA 1990, 15-16-456).

C.10.1 1,3,5-Trinitrotoluene (TNT)

TNT is one of the most widely used and the most extensively studied of the eight basic HE. It was the base compound in many of the mixed formulations used in World War II, and has been shown to be resistant to most types of biodegradation with the exception of ultraviolet light and certain types of microbes. TNT can enter the body by absorption through the skin, inhalation, or through the gastrointestinal tract. Like many of its degradation products (2,4-DNT, 2,6-DNT, 1,3,5-TNB, etc.), it can be harmful to workers. TNT causes what is known as yellow jaundice.

When fed to live animals, TNT was shown to cause cancer, but there are no corresponding data for the effects of TNT in humans. However, TNT poisoning in humans has been extensively documented.

C.10.2 1,3,5-Hexahydro-1,3,5-trinitrotriazine (RDX)

The carcinogenicity of RDX is controversial. Studies with rats showed that females are more readily affected than males, and the results are much more dose-dependent. The conclusions are that RDX is noncarcinogenic. Acute RDX toxicity has been observed in humans and primarily affects the central nervous system. This includes hyper-irritability, muscle twitching, generalized epileptiform, seizures, prolonged confusion, and amnesia.

C.10.3 1,3,5,7-Tetranitro-1,3,5,7-tetraazocyclooctane (HMX)

HMX is a by-product in the synthesis of RDX and is structurally similar. Although one would expect that the carcinogenic and reproductive effects and toxicity would be similar to RDX, these have not been adequately evaluated in animals. Reports of organ toxicity following exposure has showed that HMX can reach the heart, central nervous system, liver, and kidneys. The route of entry seems to be important in the results obtained. HMX was found not to be mutagenic with or without metabolic activation.

C.10.4 Pentaerthritol-tetranitrate (PETN)

PETN is a most sensitive secondary explosive. It is used in primer formulation, as a vasodilator in the treatment of angina in which a decrease in systolic and diastolic blood pressure is observed. It has been evaluated in low-dose animal tests, but no long-term data are available. In the short term, therapeutic treatments are infrequent-reversible effects such as headaches, nausea, and skin allergies. PETN was found not to be mutagenic.

C.10.5 2,4,6-Trinitrophenylmethyl-nitramine (Tetryl)

Tetryl is a booster explosive that is known to cause dermal and respiratory irritation. It will stain the skin, hands, neck, and hair yellow. Tetryl is a potential mutagen in humans, but no conclusive evidence exists on its carcinogenic nature.

C.10.6 Ammonium Picrate (Explosive D)

Explosive D has been shown to hydrolyze to picric acid in aqueous solutions. It is readily absorbed through the skin and lungs. Workers exposed to the dust of this explosive have shown skin and nasal cavity staining, and granular deposits (picrate) in the blood, kidney, thyroid, and adrenal gland. Also, picric acid is known to severely affect the central nervous system and to cause jaundice in workers, as well as causing dermatitis. Explosive D can cause chromosomal damage.

C.10.7 Lead

Lead is a cumulative poison and the early effects are nonspecific: except by laboratory testing, they are difficult to distinguish from the symptoms of minor seasonal illnesses. The individual who has lead poisoning will have decreased physical fitness, increased fatigue, sleep disturbance, headaches, aching bones and muscles, digestive symptoms, abdominal pain, and a decrease in appetite.

C.10.8 Barium

Barium's toxic effect to humans is low, but still of concern.

C.10.9 Beryllium

Beryllium and its salts are highly toxic, and soil contaminated with this metal should be handled with the greatest of care. Entrance into the body is via inhalation. Symptoms of Be poisoning are nonproductive coughs, substernal pain, moderate shortness of breath, and some weight loss. Soluble beryllium salts are cutaneous sensitizers as well as primary irritants. If a crystal of beryllium salt becomes imbedded in an open cut in the skin, it may cause granulomatous lesions that must be surgically removed. The maximum allowable concentration of beryllium dust in an eight-hour day is recommended to be 2 ug/cu meter in the work area.

C.10.10 Cadmium

Cadmium and solutions of its compounds are toxic. Acute toxicity is caused by inhalation of cadmium fumes or dust. Symptoms include severe pulmonary infection, chest pains, dyspnea, coughs, and general weakness.

C.10.11 Chromium

Exposure to dust and fumes can cause coughing, wheezing, headaches, fever, loss of weight, and dyspnea.

C.10.12 Mercury

Mercury, an acute toxic silvery liquid metallic element, is a very dangerous health hazard to humans. When heated, it emits highly toxic fumes. When at equilibrium with the supply of mercury, the vapor concentration of this element, even at room temperature, can exceed 200 times the allowable limit.

Mercury can be absorbed through the respiratory tract following the inhalation of the vapor or finely divided dust, or through the skin or the alimentary tract. Organic compounds of mercury are easily absorbed through the skin.

Acute mercury poisoning results in damage to the kidneys, whereas chronic mercury poisoning damages the nervous system. This damage is serious and may be permanently disabling.

C.10.13 Uranium

Radioactive uranium, with direct exposure to cells and tissue, causes injuries such as skin damage or erythema, shortening of the life span of blood-forming organs, nonspecific shortening of life span, induction of cancer or cataracts, and impaired fertility. With excessive exposure to ionizing radiation, all of these effects are irreversible.

Uranium is an alpha emitter and can penetrate the clothing or dead cells of the epidermis. Uranium is both an internal and external hazard. In the case of a large acute dose or continued chronic overexposure, there is the possibility that nonreversible damage will occur. The high rates of leukemia among radiologists, bone cancer among radium dial painters, and lung cancer among miners in Czechoslovakia, Germany, and the US all point to radiation as the causative agent.

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APPENDIX D

PLATES FOR OU 1085

LIST OF PLATES FOR OU 1085

APPENDIX E

FIELD AND LABORATORY INVESTIGATION METHODS

E.1 GENERAL

This appendix has been prepared to describe the common elements that apply to the conduct of field investigations at Operable Unit (OU) 1085 potential release sites (PRSs). The purpose of providing this information in a single discussion is to reduce the repetition of details that is common in each of the six sampling and analysis plans. Several general assumptions apply to all of the field investigations presented in Chapter 5 of this work plan. They include the following:

- The release and presence of hazardous constituents at some PRSs may not have been associated with the release of radioactive materials. Also, the release of radioactive materials may have occurred without simultaneous release of hazardous constituents.

- Field surveys and field screening of samples can be used to identify gross contamination and assist in sample selection for laboratory analyses.

- Field laboratory analyses will be used to more quickly provide Level II/III data to help guide field operations and identify samples for analytical laboratory analysis. Refer to Table E-1 for analytical levels appropriate to data uses.

- Analytical laboratory analysis will complete the sampling planned at each phase of site investigation.

E.1.1 Field Operations

The sampling and analysis plans in Chapter 5 of this work plan represent the results of research and investigation up to this point in time. These sampling and analysis plans do not present the full level of detail necessary for complete field implementation. Additional specific detail will be added to the current sampling and analysis plans prior to going to the field for sample collection.

A standard table is used in this work plan to identify screening and analysis requirements, including the number of samples and types of analyses needed (Table E-2). A step-by-step approach to the collection of sample data is used at OU 1085 and, therefore, not every sample or every analyte that is listed on the sampling and analysis summary tables will necessarily be performed. The final number of samples and laboratory analyses will vary depending on the results of the intermediate steps of field screening and field laboratory analysis.

A complete readiness review will be conducted prior to initiation of the field investigation portion of the OU 1085 RCRA Facility Investigation (RFI). This review will ensure that archaeological and

TABLE E-1

SUMMARY OF ANALYTICAL LEVELS APPROPRIATE TO DATA USES (EPA 1987, 0086)

DATA USES	ANALYTICAL LEVEL	TYPE OF ANALYSIS	LIMITATIONS	DATA QUALITY
• Site characterization • Monitoring during implementation	Level I	• Field screening for organic vapor and radiological detection using portable instruments • Field test kits	• Instruments respond to naturally occurring compounds	• If instruments calibrated and data interpreted correctly, can provide indication of contamination
• Site characterization • Evaluation of alternatives • Engineering design • Monitoring during implementation	Level II	• Variety of organics by GC; Inorganics by AA, XRF	• Tentative identification is analyte-specific • Techniques/instruments limited mostly to volatiles, metals, some radionuclides	• Dependent on QA/QC steps employed • Data typically reported in concentration ranges • Detection limits vary from low ppm to low ppb
• Risk assessment • Site characterization • Evaluation of alternatives • Engineering design • Monitoring during implementation	Level III	• Organics/inorganics using EPA procedures other than CLP can be analyte-specific • RCRA characteristic tests • Radiological constituents	• Specific identification; tentative identification in some cases • Can provide data of same quality as Level IV	• Similar detection limits to CLP • Less rigorous QA/QC
• Risk assessment • Evaluation of alternatives • Engineering design	Level IV	• TCL/TAL organics/ inorganics by GC/MS, AA, ICP	• Tentative identification of non-TCL parameters • Some time may be required for validation of packages	• Goal is data of known quality • Rigorous QA/QC • Low ppb detection limit
• Risk assessment	Level V	• Non-conventional parameters • Appendix 8 parameters	• May require method development/modification • Mechanism to obtain services requires special lead time	• Quality is method specific • Method-specific detection limits

AA: Atomic absorption
CLP: Contract laboratory program
EPA: Environmental Protection Agency
GC: Gas chromatography
ICP: Inductively coupled plasma
MS: Mass spectrometry
RCRA: Resource Conservation and Recovery Act
TAL: Target analyte list
TCL: Target compound list
XRF: X-ray fluorescence

TABLE E.2

SUMMARY OF SITE SURVEYS, SAMPLING, AND ANALYSIS FOR AGGREGATE NAME

			FIELD SURVEY			SAMPLES									FIELD SCREENING						FIELD LABORATORY						LABORATORY ANALYSES																
							STRUCTURE		SURFACE		SUBSURFACE																																
PRS	PRS TYPE	PHASE I APPROACH	LAND SURVEY	GEOPHYSICS	RADIATION	SAMPLED MEDIA		DUP		DUP		DUP	NEIGHBORS		GROSS ALPHA	GROSS GAMMA/BETA	ORGANIC VAPOR	BTEX	X-RAY FLUORESCENCE	HIGH EXPLOSIVES	GROSS ALPHA	TRITIUM	SOIL MOISTURE	GAMMA SPECTROSCOPY	XRFGC/FID	VOA	GAMMA SPECTROSCOPY	TRITIUM	TOTAL URANIUM	ISOTOPIC URANIUM	ISOTOPIC PLUTONIUM	ISOTOPIC THORIUM	VOA (SW 8240)	SEMIVOLATILES (SW 8270)	TCLP METALS	METALS (SW 6010)	PCB (SW 8080)	ASBESTOS	MERCURY	CYANIDE	HERBICIDES	HIGH EXPLOSIVES	AGGREGATE

ecological evaluations will be performed in all areas where the surface is to be disturbed, vegetation removed, or invasive sampling performed.

This discussion identifies several aspects of the Laboratory's implementation of the field sampling process that are not mentioned in the specific sampling and analysis plans. Standard field operations include (see Section 2.0, Field Operations Management):

- preliminary activities and support procedures required by the Laboratory;
- identifying and documenting locations that have been sampled;
- field sample logging, handling, documentation, and Environmental Restoration (ER) Program Sample Management Facility (SMF) sample management and curation procedures;
- analytical sample handling and sample coordination facility (SCF) laboratory coordination procedures;
- equipment decontamination procedures; and,
- management of wastes generated by sampling and decontamination activities.

E.1.2 Investigation Methods

The primary focus of this appendix is on field investigation methods, discussed in the field sampling methods subsection of the Laboratory's Installation Work Plan (IWP), Subsection 3.5.3 (LANL 1992, 0768). The methods presented here are specific examples of the options identified in the IWP. In addition, this appendix references the Laboratory's ER Program standard operating procedures (SOPs) (LANL 1993, 0875). Each brief method description given here refers to the applicable SOPs for detailed methodology .

The method descriptions are simple and brief and provide some information on applying the method. Specific information, such as sampling location or target depth of a borehole, is provided by the individual sampling and analysis plans in Chapter 5 of this work plan. The method descriptions presented here are not intended to supplant or reduce the importance of the Quality Assurance Project Plan (Annex II) of this work plan or the governing SOPs (LANL 1993, 0875). Wherever a Laboratory ER Program SOP is referenced in this work plan, revision numbers are intentionally not listed. Most SOPs will undergo revision between completion of this work plan and commencement of field activities. Therefore, the most current revision of the SOP will be used when activities that require implementation of the SOP are undertaken. Table E-3 lists the SOPs applicable to the OU 1085 Work Plan.

E.2.0 FIELD OPERATIONS MANAGEMENT

Multiple field investigation teams may be operating concurrently during the RFI. Each team will be responsible for health and safety, sample identification and traceability, and related activities. In this section, several aspects of field operations are described that will occur as a part of all field operations. Other responsibilities may be shared between field teams, such as operation of the portable sample logging facility or an equipment decontamination facility.

E.2.1 Health and Safety

Annex III of this work plan is the Health and Safety Project Plan for all field activities within OU 1085. The plan gives specific information regarding known or suspected contaminants and personnel protection required for different activities. Samples acquired as part of this work plan will be screened at the point of collection to identify the presence of gross contamination or conditions that may pose a threat to the health and safety of field personnel. The techniques listed in Section 5.0, Field Screening, will be used.

Access, staging, and sample storage areas will be designated by the field team leader (FTL). In order to maintain sample integrity and sample documentation, all sampling sites will be included in one or several exclusion zones. Exclusion zones will be delineated by the FTL with the concurrence of the site safety officer (SSO). The boundary of an exclusion zone will be defined based on the nature, magnitude, and extent of confirmed or possible contamination; the potential for contaminant migration; hazards at the site, such as use of mechanical equipment; the presence of electrical lines or other utilities, structures, tanks, pits, or trenches; and, the presence of steep banks or cliffs.

Boundaries of exclusion zones may be changed as operations progress. All changes will be designated by the FTL, with the concurrence of the SSO.

In order to assure sample integrity, to maintain control over sampling waste, and to avoid contamination of the site office, decontamination may be required for personnel, equipment, and vehicles moving from one zone to another. Therefore, a contamination reduction zone (CRZ) will be established surrounding the exclusion zone(s). A contamination reduction corridor, the size of which will depend on the number of stations required for decontamination activities, will be

Table E-3

Standard Operating Procedures Cited for OU 1085 Field Activities

TITLE	NUMBER
General Instructions for Field Investigations	LANL-ER-SOP-01.01
Sample Containers and Preservation	LANL-ER-SOP-01.02
Handling, Packaging, and Shipping of Samples	LANL-ER-SOP-01.03
Sample Control and Field Documentation	LANL-ER-SOP-01.04
Field Quality Control Samples	LANL-ER-SOP-01.05
Management of RFI-Generated Waste	LANL-ER-SOP-01.06
Equipment Decontamination	IN PREPARATION
Safety Procedures for Taking Soil Samples in Explosives Areas	IN PREPARATION
MCA-465/FIDLER Instrument System	LANL-ER-SOP-10.04
Near Surface Soil Sample Screening for Low-Energy Gamma Radiation Using the Phoswich	IN PREPARATION
Measurement of Gamma Radiation Using Sodium Iodide (NaI) Detector	LANL-ER-SOP-06.23
Drilling Methods and Drill Site Management	LANL-ER-SOP-04.01
Spade and Scoop Method for Collection of Soil Samples	LANL-ER-SOP-06.09
Hand Auger and Thin-Wall Tube Sampler	LANL-ER-SOP-06.10
Stainless Steel Surface Soil Sampler	LANL-ER-SOP-06.11
Sediment Material Collection	LANL-ER-SOP-06.14
Field Logging, Handling, and Documentation of Borehole Materials	LANL-ER-SOP-12.01
Transportation, Receipt, and Admittance of Borehole Samples for the Sample Management Facility	LANL-ER-SOP-12.01

established through the CRZs. The corridor should be located in a direction that is generally upwind from the exclusion zone.

E.2.2 Site Monitoring

Entry to, and egress from, sites will be controlled for monitoring purposes. All personnel entering the sites must use appropriate radiation monitoring badges. Locations for drinking water, rest room facilities, etc., will be identified prior to beginning on-site activities. Protective clothing requirements will be determined by the SSO assigned to the project.

Field measurements for wind-borne contaminants shall be made and documented prior to, during, and after surface sampling activities. Qualified health and safety personnel (or designees) are responsible for this monitoring. Results of monitoring will be used to evaluate possible hazards existing at the site in order to evaluate current conditions and specify personal protective equipment. In addition, all personnel will visually monitor for extreme weather conditions, lightning, or other physical or environmental hazards that may develop. Personnel will notify the SSO when unanticipated physical or environmental hazards develop. Potential site hazards are discussed in detail in Annex III of this work plan.

E.2.3 Archaeological and Ecological Awareness

Prior to going into the field, the OU 1085 field teams will be briefed about the cultural and ecosystem sensitivities present at OU 1085. Field teams will abide by the mitigative measures prescribed for archaeological and ecological features or systems identified for OU 1085. Refer to Appendix A and Appendix B of this work plan.

E.2.4 Support Services

Physical services support during the field investigation will be provided by Laboratory support groups [e.g., Engineering (ENG-3, ENG-5,) Johnson Controls, or other subcontractors]. Existing job ticket procedures will be used. The services these organizations will provide include, but are not limited to, backhoe and front-end loader excavations, moving pallets of drummed auger cuttings and decontamination solutions, and setting up signs and other warning notices around the perimeter of the work area.

E.2.5 Excavation Permits

As part of the Environmental Safety and Health (ES&H) questionnaire process, excavation permits are required by the Laboratory prior to any excavation, drilling, or other invasive activity.

Acquisition of the permits will be coordinated with the Laboratory's Safety and Risk Assessment Group (HS-3) and Johnson Controls. Acquisition of excavation permits will be scheduled as appropriate for each phase of fieldwork. All areas intended for excavation, drilling, or sampling will be marked in the field for formal clearance prior to beginning the work.

E.2.6 Sample Management

Regulatory requirements governing the ER Program mandate the implementation of sample controls as part of the quality assurance program. Sample traceability (chain-of-custody) will be established by the maintenance of sample histories during collection, transportation, processing, testing, and storage activities. Appropriate processing of field samples prior to testing and analysis is necessary to ensure that data from samples are accurate; from collection in the field, to their distribution to the analytical laboratory, or receipt at the SMF, and to their final storage or disposal.

A SMF has been established by the ER Program. The ER Program SMF has been developed to assure quality control of all geologic samples and associated records, including their physical protection and traceability. The sample management system will be described in the revised Quality Assurance Project Plan (QAPjP). Guidance for sample handling is provided in Subsection 3.5.5 and Annex IV of the IWP (LANL 1992, 0768). Sample packaging, handling, traceability, and documentation procedures are provided in ER Program SOPs. Refer to Table E-3 for a complete listing of applicable SOPs.

E.2.7 Sample Coordination

A sample coordination facility has been established by the ER Program in the Laboratory's Environmental Chemistry Group (CST-9) to provide consistent and cost-effective analytical methods for all investigations. The system is described in Subsection 3.5.5 and Appendix 0 of the IWP (LANL 1992, 0768). The applicable SOP is LANL-ER-SOP-01.04, Sample Control and Field Documentation (LANL 1993, 0875).

E.2.8 Quality Control Samples

Field quality assessment samples of several types are collected during the course of a field investigation. The definition for each kind of sample and the purpose it is intended to fulfill are given in Annex II of this work plan, the Quality Assurance Project Plan (QAPjP), and in LANL-ER-SOP-01.05, Field Quality Control Samples (LANL 1993, 0875). The specific number of geotechnical field duplicate samples that are to be collected is detailed in the sampling plans in Chapter 5, Tables 5-X-1 of this work plan.

E.2.9 Equipment Decontamination

Decontamination is performed as a quality assurance measure, an environmental protection activity, and a safety precaution. It prevents cross-contamination among samples and helps maintain a clean working environment for the safety of personnel. Sampling tools are decontaminated by washing, rinsing, and drying. The effectiveness of the decontamination process is documented through rinsate blanks submitted for laboratory analysis. Steam cleaning is used for large machinery, vehicles, auger flights, and coring tools used in borehole sampling. Decontamination wastewaters, including steam-cleaning fluids, must be collected and contained for proper disposal. The applicable SOP is Equipment Decontamination (in preparation) .

E.2.10 Waste Management

This discussion is based on the guidance provided in Subsection 3.5.4 and Appendix B of the IWP (LANL 1992, 0768). Wastes produced during sampling activities may include borehole auger cuttings, excess sample, excavated soil from trenching, decontamination wastewaters and steam-cleaning fluids, and disposable materials such as wipes, protective clothing, and sample bottles. In different areas of OU 1085, several of the following waste categories may be encountered: hazardous waste, low-level radioactive waste, and mixed waste. Requirements for segregating, containing, characterizing, treating, and disposing of each type and category of waste are provided in the applicable SOP, LANL-ER-SOP-01.06, Management of RFI-Generated Waste (LANL 1993, 0875).

E.3.0 FIELD SURVEYS

Field surveys will primarily consist of walking scans of the land surface using direct reading or recording instruments. Field survey data such as radioactivity or organic vapor measurements are used to identify the presence of contaminants or structures in the field and to modify health and safety plans. While negative results from field surveys are not conclusive evidence as to the absence of contaminants, positive results obtained at an early stage can allow timely redirection of sampling activities.

E.3.1 Land Surveys

Land surveys will include engineering and geomorphologic mapping activities.

E.3.1.1 Engineering Mapping

Geodetic engineering mapping is required to accurately record the location of PRSs and surface and subsurface sampling points. In the field the engineering survey will locate, stake, and document all PRS locations (that can be ascertained before sampling) and all surface engineering features and structures. The assumed locations of subsurface structures will be surveyed based upon existing engineering drawings. These data will be recorded on a base map scaled 1:7 200. If repositioning a sample location becomes necessary during sample collection, this new position will be resurveyed and the revised location will be indicated on the base map.

E.3.1.2 Geomorphologic Mapping

Field or geomorphologic mapping will be required for OU 1085 to assist in the location of certain sampling points. In order to sample drainages judged most likely to contain potential contamination, four individual sampling plans in Chapter 5 required identification of drainages. See Table E-3 for information on the applicable SOPs.

E.3.2 Geophysical Surveys

Various geophysical methods are available to detect the location of buried structures (e.g., septic systems) and to trace the path of buried material such as piping. If the few subsurface features at OU 1085 cannot be adequately located by mechanical means (probing), then the ER Program technical team that maintains expertise in geophysical techniques will be consulted for the most appropriate method(s).

E.3.3 Radiological Surveys

E.3.3.1 Gross Gamma Survey

Several instruments are available that are suitable for these surveys: micro R meters, sodium-iodide (NaI) detectors of various ratemeters or scalers, and Geiger-Müeller detectors. The preferred instruments are micro R meters with the ability to measure to 5μ R/hr, and 2-in. by 2-in. NaI detectors with a ratemeter capable of displaying 100 counts per minute (cpm). Some discrete-measurement or continuous-measurement recording instruments are also available using the same detectors. Surveys are conducted by carrying the instrument at waist height at a slow walking pace and observing the ratemeter response. Measurements may also be made at ground surface to aid in identifying the presence of localized contamination. See Table E-3 for information on the applicable SOPs.

E.4.0 SOIL SAMPLING

Soil samples, taken as described below, will be used for field screening, field laboratory, and analytical laboratory measurements and analyses. The following table, Table E-4, correlates sample collection techniques with soil sampling categories.

Table E-4

Dry Media Sampling Techniques Used For OU 1085[1,2]

TECHNIQUE	SURFACE SOILS 0 to 6 in.	SURFACE SOILS 0 to 12 in.	SUBSURFACE SOILS AND ROCK 12 in. and deeper
Spade and scoop	X		
Ring sampler	X		
Hand-auger and thin-wall tube	X	X	X
Vertical borehole			X

1 Table E-4 presents the choice of sampling techniques that may be used for sampling dry media for various spatial boundaries.
2 See Table E-3 for a complete listing of applicable SOPs.

E.4.1 Surface Soils: 0 to 6 in.

Depths of surface soil samples and the techniques used for their collection vary depending upon whether the samples are being gathered at a HE-contaminated firing site that has undergone weathering and mechanical disturbance over the past 40 years, or whether the samples are being evaluated for PCOC migration off site.

The spade and scoop method uses a stainless steel or Teflon scoop. Care should be taken to ensure that for each sample the hole goes the full required depth and the sides are cut vertically to obtain equal volumes over the entire interval.

The ring sampler method is a 4-in.-diameter stainless steel tube that is driven vertically into the area to be sampled. Once driven in place, the soil around the sampler is then excavated and the tube is removed.

The applicable SOPs are LANL-ER-SOP-06.09, Spade and Scoop Method for Collection of Soil Samples, and LANL-ER-SOP-06.11, Stainless Steel Surface Soil Sampler (LANL 1993, 0875).

E.4.2 Surface Soils: 0 to 12 in.

Small-volume soil samples can be recovered from depths approaching 10 ft with a hand auger or with a thin-wall tube sampler. The thin-wall tube sampler provides a less disturbed sample than that obtained with a hand auger. However, it may not be possible to force the thin-wall tube sampler through some soil or tuff, and sampling with the hand auger may be the more viable alternative. It is usually not practical to use a hand auger or thin-wall tube sampler at depths below 10 ft. The applicable SOP is LANL-ER-SOP- 06.10, Hand Auger and Thin-Wall Tube Sampler (LANL 1993, 0875).

E.4.3 Subsurface Soils and Rock

Subsurface soils and rocks will be sampled with vertical boreholes at OU 1085.

E.4.3.1 Vertical Cored Boreholes

Any drilling specified at OU 1085 will be accomplished through the use of the most efficient and applicable methods available. Generally, core sampling will be accomplished using an auger rig that drives hollow-stem augers and is fitted with a continuous sampler system. However, in an effort to minimize the generation of waste (cuttings from augering), mechanical drive core drilling systems are also being considered for any site where the management of hazardous or radioactive wastes are likely.

Core samples will be collected using a 5 ft-long continuous sampler with an inner liner. Auger and sampler diameters may vary depending on the media to be drilled and the specific sample that is required. Each sampling plan gives a nominal depth for each borehole; the borehole will be sampled to at least that depth, at 5-ft intervals. If contamination is detected by field screening or field laboratory measurements in the last interval above the nominal depth, sampling will continue at 5-ft intervals until contamination has dropped to at least background levels or twice the planned nominal depth of the borehole has been reached. The investigation will proceed to Phase II if contamination above background is still detected at twice the planned depth of the borehole. This stop criterion will be used for all boreholes sampled to ensure complete information on contaminant depth. In addition, the analytical set specified in each sampling plan will be followed for the complete depth of the borehole.

The applicable SOPs are LANL-ER-SOP-04.01, Drilling Methods and Drill Site Management, and LANL-ER-SOP-12.01, Field Logging, Handling, and Documentation of Borehole Materials (LANL 1993, 0875). Also see Table E-3 for additional sample handling SOPs that are applicable to core sample management.

E.4.4 Sludge or Sediment

A sludge sample will be collected from a septic tank at TA-14. Several techniques are available for the collection of sludge and sediment samples, such as a hand corer, spade and scoop, or Ponar grab. The most appropriate method will be selected by the field team leader. The applicable SOP is LANL-ER-SOP-06.14, Sediment Material Collection.

E.5.0 FIELD SCREENING

Field screening measurements are applied at the point of sample collection, in borehole headspace, and in excavations to identify gross contamination and to assess conditions affecting the health or safety of field personnel. Application of screening for personnel health and safety is detailed in Annex III of this work plan. Individual sampling plans may not explicitly identify the use or role of sample screening measurements; however, the standard analytical table for each investigation will show the methods to be used (see Section 8.0 of this appendix).

In general, every sample taken at OU 1085 will be screened for gamma, beta, and alpha radioactivity and HE. In addition to the role of sample screening to identify gross contamination or situations of concern for health and safety, field screening information will be used to direct sampling and to guide in the selection of analysis activities.

E.5.1 Radiological Screening

E.5.1.1 Gross-Gamma Radiological Screening

Field screening of samples for gross-gamma radioactivity will be done using a hand-held NaI detector probe and ratemeter. The detector is held close to the sample and is capable of identifying elevated concentrations of certain radionuclides as an increased ratemeter reading above instrument background levels. Quantification of the response is difficult and is best interpreted as a gross indicator of potential contamination.

E.5.1.2 Gross-Alpha Radiological Screening

Field screening of samples for gross-alpha radioactivity is conducted using a hand-held alpha scintillation detector and a ratemeter. The detector is held close to contact with the sample and is capable of detecting on the order of approximately 100 to 200 pCi/g for a damp soil sample. The instrument cannot identify specific radionuclides.

E.5.1.3 Gross-Beta Radiological Screening

Field screening of samples for gross beta radioactivity is conducted using a hand-held detector. A typical beta detector consists of a Geiger-Mūeller tube with a thin mica window protected by a sturdy wire screen. The mica window thickness may vary from 1.4 to 2 mg/cm^2. The detector is held close to contact with the sample or core and is capable of detecting gross beta activity down to 40 keV. The gamma sensitivity of such a detector is approximately 3 600 cpm/mR/h. The beta efficiency with screen in place is 45% for strontium-90 and 10% for carbon-14. Screen removal will increase efficiency by 45%. The efficiencies are determined as percentage of 2π emission rate, from a 1 in. diameter source. This beta detector is alpha sensitive above 3 MeV.

E.5.2 Nonradioactive Screening

E.5.2.1 Organic Vapor Detectors

Organic vapor detectors will be used to screen borehole cores and soil samples at the point of collection to identify grossly contaminated samples. Two types of detectors, photoionization detector (PID) and flame ionization detector (FID), will be used to improve the probability of detecting a wide range of vapors and are described in this subsection.

Organic vapor detectors will be used to monitor breathing zones for personnel safety in sample collection and handling areas at OU 1085 sites. PID and FID detectors will be used to survey a wide range of organic vapors as described below:

- PID. A Model PI 101 PID, or its equivalent, will be used. It is a general survey instrument capable of detecting real-time concentrations of many complex organic compounds and some inorganic compounds in air. The instrument can be calibrated to a particular compound; however, it cannot distinguish between detectable compounds in a mixture of gases. See Table E-3 for information on the applicable SOP.

- FID. A Foxboro Model OVA-128, or its equivalent, will be used. It is a flame ionization detector that can be used as a general screening instrument to detect the presence of many organic vapors. Its response to an unknown sample is relative to the response to a gas of known composition to which the instrument has been calibrated. See Table E-3 for information on the applicable SOP.

- Combustible Gas/Oxygen Detector. A Gastech Model 1314 or its equivalent will be used to determine the potential for combustion or explosion of unknown atmospheres during drilling and intrusive activities. A typical combustible gas indicator (CGI) determines the level of organic vapors and gases present in an atmosphere as a percentage of the lower explosive limit or lower flammability limit. The Gastech Model 1314 also contains an oxygen detector to determine atmospheres that are deficient or enriched in oxygen. For health and safety purposes, the CGI will be used (if appropriate) to monitor atmospheres during some intrusive activities. See Table E-3 for information on the applicable SOP.

E.5.2.2 X-Ray Fluorescence Probe for Metals

X-ray fluorescence (XRF) is a technique for analyzing metals in solids. The instrument consists of a source for sample excitation (x-ray tube), a detector or proportional counter, a sample chamber, and an energy analyzer. The XRF instrument will be used for detection of metals on solid surfaces. Dried soil or crushed debris samples are placed in a sample chamber, excited, and counted for finite periods (such as 400 seconds). Detection limits for metals in soils must be low enough to ascertain whether action levels for metals in soil or debris will be exceeded. Even if action-level detection limits cannot be achieved in field instruments, gross concentrations of metals may be detected. This will be valuable information for soil or debris assessment. There is no ER SOP for XRF; calibration and field procedures recommended by the instrument manufacturer will be followed.

E.5.2.3 Field Spot-Test Kit for Explosives

The spot-test kit was developed to identify the presence of explosives as contaminants on equipment and environmental media. Three reagents in a carrying case with a portable ultraviolet (UV) lamp, can be used to detect any of the common explosives used at Los Alamos. After a suspect area or material is wiped with a clean filter paper, a drop of each of three reagents placed on different parts of the sample will change color when explosives and/or nitrogen compounds are present. A UV light (short wavelength, 254 nm) enhances color for RDX/HMX explosives. For checking soil contaminated with TNT, it is possible to detect a content as low as 0.01% (100 ppm) as determined by laboratory experiments (Baytos 1991, 0741).

E.5.2.4 BTEX Field Spot-Test Kit for Petroleum Hydrocarbons

The BTEX spot-test kit will detect compounds associated with petroleum fuels and lubricants including benzene, toluene, ethylbenzene, and various forms of xylene. The detection system is based on the immunoassay technique. A disposable analyte detector is coated with antibodies specific to gasoline components. Soil samples are extracted with methanol and then analyzed in a hand-held reflectometer. The resulting concentration is read out directly in ppm. The minimum concentration detected is in the range of 1 to 10 ppm.

E.6.0 FIELD LABORATORY ANALYSIS

Field laboratory methods result primarily in Level II data, although some are Level I (more qualitative) or near Level III (more quantitative). These techniques generally provide better quality information, including lower detection limits, than can be obtained with field screening.

The three major uses of field laboratory data are:

- To aid in the course of fieldwork, thereby increasing the efficiency of field operations. As an example, field laboratory measurements can be used to determine when to cease drilling a borehole.
- To focus more quantitative analytical efforts on the key samples. Depending on the goals of the investigation, samples having particular characteristics can be selected; for example, those with no detectable contaminants to assess the edge of a plume; those with the highest levels of contaminants to ascertain sources.

- To quickly and cost-effectively analyze a large number of samples for easily detectable contaminants. This can reduce the number of samples that the analytical laboratory must send for more costly analysis. The large number of lower-quality measurements provides a broad base of comparison for the few high-quality measurements, which helps determine if the latter are representative and sufficient for decision making.

E.6.1 Radiological Measurements

E.6.1.1 Gross Alpha

Measurements of gross alpha radioactivity can be used to ascertain the presence of plutonium, uranium, and thorium in samples, but not to identify individual radionuclides. A typical method uses dried soil samples in a fixed geometry. Level II measurements can detect alpha-emitting radionuclides at concentrations on the order of 25 to 40 pCi/g, sufficient for guiding field operations or selection of samples for further analysis. Typical measurement times are 15 to 20 minutes per sample using large-area, zinc-sulfide, alpha scintillation detectors and a scaler. A Model 43-10 alpha scintillation detector, other equivalent, and a Ludlum Model 2200 scaler are appropriate.

E.6.1.2 Gamma Spectrometry

Gamma-ray spectrometry can be used to quantify particular radionuclides present in soil samples, such as cesium-137, cobalt-60, and uranium-234, -235, and -238. It can also detect the 60-keV gamma ray from americium- 241. Rapid-turnaround analysis can be Level II or close to Level III quality, using personal computer-based, multichannel analyzers (MCA) and NaI or germanium photon detectors; for example, a Canberra MCA with a Ludlum 44-10 NaI detector. Many equivalent instruments are available. Dried soil samples in fixed geometries can be analyzed in 20 to 30 minutes with detection limits on the order of 5 pCi/g for radionuclides such as cesium-137.

E.6.2 Organic Chemical Measurements

E.6.2.1 Volatile Organic Compounds

Rapid-turnaround analysis for volatile organic compounds at Level II quality is needed to guide field operations such as drilling. An instrument that can distinguish between compounds, such as the Laboratory's transportable purge-and-trap gas chromatograph/mass spectrometer (GC/MS), is preferred because it can provide qualitative and quantitative analyses of most volatile organic compounds with low or slight solubility in water (boiling points below 200°C). Volatile water-soluble compounds can also be detected with higher detection limits.

E.7.0 LABORATORY ANALYSIS

As described in Section 2.0 of this appendix, samples to be submitted to an analytical laboratory will be coordinated, handled, and tracked by the ER Program SCF (CST-9).

The following list provides references for methods and analytical levels for the parameters which appear in the laboratory analysis columns of the screening and analysis summary tables for each aggregate (see Section 8.0).

Gamma spectroscopy. Radionuclides will be quantified by measurement of photon emissions. Quantitation limits are given in LANL-ER-QAPjP, Table V.8 (LANL 1991, 0553).

Isotopic uranium. Chemical separation of plutonium from soil is followed by alpha spectrometry to quantify each isotope of uranium. Quantitation limits are given in LANL-ER-QAPjP, Table V.8 (LANL 1991, 0553).

Volatile organic compounds (SW-846 Method 8240). EPA standard method for quantification of volatile organic compounds. The standard list of analytes and quantitation limits is given in LANL-ER-QAPjP, Table V.4 (LANL 1991, 0553).

Semivolatile organic compounds (SW-846 Method 8270). EPA standard method for quantification of semivolatile organic compounds. The standard list of analytes and quantitation limits is given in LANL-ER-QAPjP, Table V.4 (LANL 1991, 0553).

Metals (SW-846 Method 6010). EPA standard method for quantification of metals. The standard suite of metals to be analyzed for at OU 1085 unless otherwise stated is: beryllium, barium, cadmium, lead, chromium, and uranium for TA-12; barium, beryllium, cadmium, lead, uranium, chromium, copper, nickel, arsenic, and zinc for TA-14. Quantitation limits are given in LANL-ER-QAPjP, Table V.7 (LANL 1991, 0553).

Explosives (SW-846 Method 8330). EPA standard method for quantification of explosive compounds. The standard list of analytes and quantitation limits is given in LANL-ER-QAPjP, Table V.10 (LANL 1991, 0553).

E.8.0 SCREENING AND ANALYSIS SUMMARY TABLE

A standard table is used in this work plan to identify screening and analysis requirements, including the number of samples and types of analyses needed. Table E-2 is an example of a screening and analysis summary table, referred to in several sections of this appendix.

E.8.1 PRS and Investigation Approach

The three columns on the left side of Table E-2 identify, by PRS (SWMU, area of concern, aggregate, or other logical sampling unit), the PRS type (a brief description of the PRS) and the investigative approach at this PRS (reconnaissance, VCA, extent).

E.8.2 Field Surveys

The fourth through sixth columns of Table E-2 identify field surveys. These are primarily engineering mapping activities or walking surveys of the land surface, using direct reading or recording instruments. For OU 1085 these surveys will include geodetic and geomorphologic surveys, and radiation surveys. The radiation surveys will consist of the evaluation of low-level gamma radiation.

E.8.3 Samples

The seventh through fourteenth columns of Table E-2 identify samples and duplicate samples (see Subsection 2.8, Quality Control Samples). Individual columns indicate whether samples are to be collected from structures, surface, or subsurface domains. All sampling techniques are associated with a primary domain but may yield samples from multiple domains. Hand auger samples, for example, will always yield a surface component in addition to the near-surface and subsurface component. Single or multiple specimens may be created from a sample. For example, a soil sample collected in the field will normally represent only one specimen, whereas a subsurface core will provide many specimens. This section of the table includes a column to identify the sampled media (i.e., soil, tuff, sludge) and the numbers of samples and quality duplicates collected for each PRS or sampling unit.

E.8.4 Field Screening

Columns fifteen through twenty-one of Table E-2 indicate which field screening is to be performed. Field screening measurements are taken at the point of sample collection, in borehole headspace, and in excavations to identify gross contamination and to assess conditions affecting health and safety of field personnel. Specific field screening categories at OU 1085 include gross alpha, beta and gamma, organic vapors, BTEX, XRF, and explosives.

E.8.5 Field Laboratory Measurements

Table columns twenty-two through twenty-seven of Table E-2 designate field laboratory analyses to be performed. The field laboratory is to obtain rapid-turnaround analysis of samples, using a limited number of relatively simple analytical methods. Specific field laboratory categories applicable to work at OU 1085 include gross alpha, gamma spectroscopy, volatile organic compounds by gas chromatography/mass spectrometry, flame ionization detection, and volatile organic compounds.

E.8.6 Laboratory Analysis

Columns twenty-eight through forty-three of Table E-2 designate full laboratory analyses that are to be performed on specimens. The lack of existing data from a PRS creates the need to verify the presence of a wide spectrum of possible contaminants. Analytical laboratories that are not located in the field provide the highest quality (Level III/IV) data; all samples submitted to an analytical laboratory will be handled and tracked by the ER Program SCF. See Section 7.0 for a complete list of the laboratory analysis methods that will be performed at OU 1085.

REFERENCES

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), November 1991. "Installation Work Plan for Environmental Restoration," Revision 1, Los Alamos National Laboratory Report LA-UR-91-3310, Los Alamos, New Mexico. **(LANL 1991, 0553)**

LANL (Los Alamos National Laboratory), November 1992. "Installation Work Plan for Environmental Restoration," Revision 2, Los Alamos National Laboratory Report LA-UR-92-3795, Los Alamos, New Mexico. **(LANL 1992, 0768)**

LANL (Los Alamos National Laboratory), January 1993. "Environmental Restoration Standard Operating Procedures," Los Alamos, New Mexico. **(LANL 1993, 0875)**

TA-12 FEATURES IN TA-15

TA-12 Features in TA-15

LEGEND

- Boundary, OU
- Boundary, TA
- Contours, 2 foot
- Contours, 10 foot
- PRS, Absent
- PRS, Present
- PRS, Probable
- PRS, Possible
- Roads, Dirt
- Roads, Paved
- Road/Trail
- Former Structure
- Permanent Structure
- Temporary Structure
- PRS, Point Location
- Telephone Pole

State Plane Coordinate System, New Mexico Central Zone.
1983 North American Datum

Grid provides New Mexico State Plane coordinates in feet.
Grid interval, in feet: 500

Notice: The information on this map is provisional and has not been checked for accuracy. Maps should not be relied upon to establish legal claims, boundary lines or locations of improvements.

Basemap Sources: Utility and structure data are from Los Alamos National Laboratory Engineering Division and Los Alamos County Utility and Engineering Departments. Contour data is from Los Alamos National Laboratory Environmental Restoration Program aerial survey, September, 1991.

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CHAPTER 5 PRS's AT TA-14

Chapter 5 PRS's at TA-14

LEGEND

- Boundary, OU
- Boundary, TA
- Contours, 2 foot
- Contours, 10 foot
- Fence, Industrial
- Fence, Security
- PRS, Absent
- PRS, Present
- PRS, Probable
- PRS, Possible
- Roads, Dirt
- Roads, Paved
- Road/Trail
- Former Structure
- Permanent Structure
- Temporary Structure
- Underground Structure
- PRS, Point Location

N

State Plane Coordinate System, New Mexico Central Zone.
1983 North American Datum

Grid provides New Mexico State Plane coordinates in feet.
Grid interval, in feet: 500

METERS

FEET

Notice: The information on this map is provisional and has not been checked for accuracy. Maps should not be relied upon to establish legal claims, boundary lines or locations of improvements.

Basemap Sources: Utility and structure data are from Los Alamos National Laboratory Engineering Division and Los Alamos County Utility and Engineering Departments. Contour data is from Los Alamos National Laboratory Environmental Restoration Program aerial survey, September, 1991.

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NFA's AT TA-14

NFA's at TA-14

LEGEND

- Boundary, OU
- Boundary, TA
- Contours, 2 foot
- Contours, 10 foot
- Fence, Industrial
- Fence, Security
- PRS, Absent
- PRS, Present
- PRS, Probable
- PRS, Possible
- Roads, Dirt
- Roads, Paved
- Road/Trail
- Former Structure
- Permanent Structure
- Temporary Structure
- Underground Structure
- PRS, Point Location

N

State Plane Coordinate System, New Mexico Central Zone.
1983 North American Datum

Grid provides New Mexico State Plane coordinates in feet.
Grid interval, in feet: 500

Notice: The information on this map is provisional and has not been checked for accuracy. Maps should not be relied upon to establish legal claims, boundary lines or locations of improvements.

Basemap Sources: Utility and structure data are from Los Alamos National Laboratory Engineering Division and Los Alamos County Utility and Engineering Departments. Contour data is from Los Alamos National Laboratory Environmental Restoration Program aerial survey, September, 1991.

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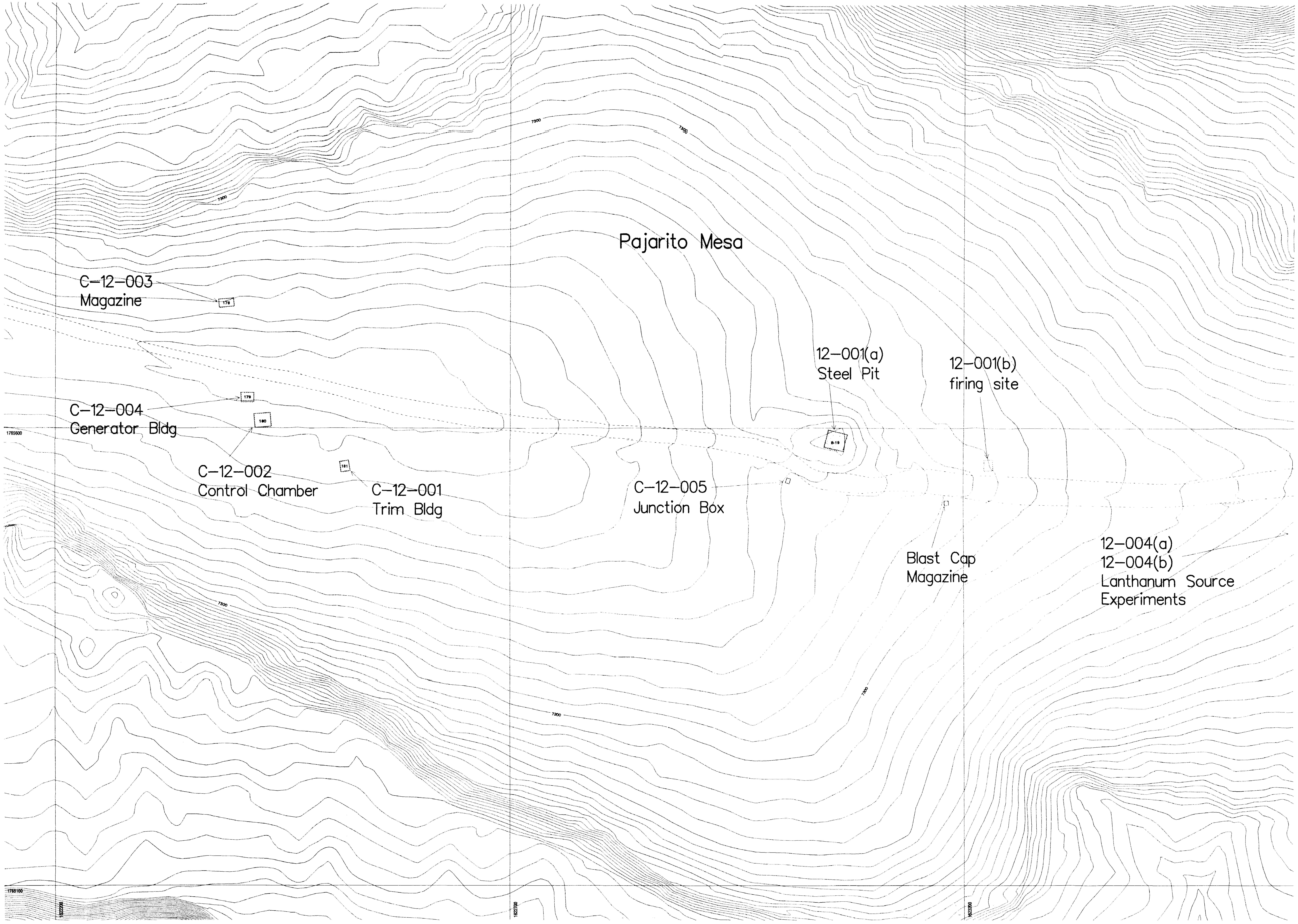
CHAPTER 5 PRS's AT TA-12



Chapter 5 PRS's at TA-12

LEGEND

- Contours, 2 foot
- Contours, 10 foot
- Fence, Industrial
- Fence, Security
- PRS, Absent
- PRS, Present
- PRS, Probable
- PRS, Possible
- Roads, Dirt
- Roads, Paved
- Road/Trail
- Former Structure
- Permanent Structure (B-19)
- Temporary Structure
- Underground Structure

N

State Plane Coordinate System, New Mexico Central Zone.
1983 North American Datum

Grid provides New Mexico State Plane coordinates in feet.
Grid interval, in feet: 500

METERS

FEET

Notice: The information on this map is provisional and has not been checked for accuracy. Maps should not be relied upon to establish legal claims, boundary lines or locations of improvements.

Basemap Sources: Utility and structure data are from Los Alamos National Laboratory Engineering Division and Los Alamos County Utility and Engineering Departments. Contour data is from Los Alamos National Laboratory Environmental Restoration Program aerial survey, September, 1991.

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