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RFI Work Plan for Operable Unit 1086

Environmental Restoration Program

July 1993

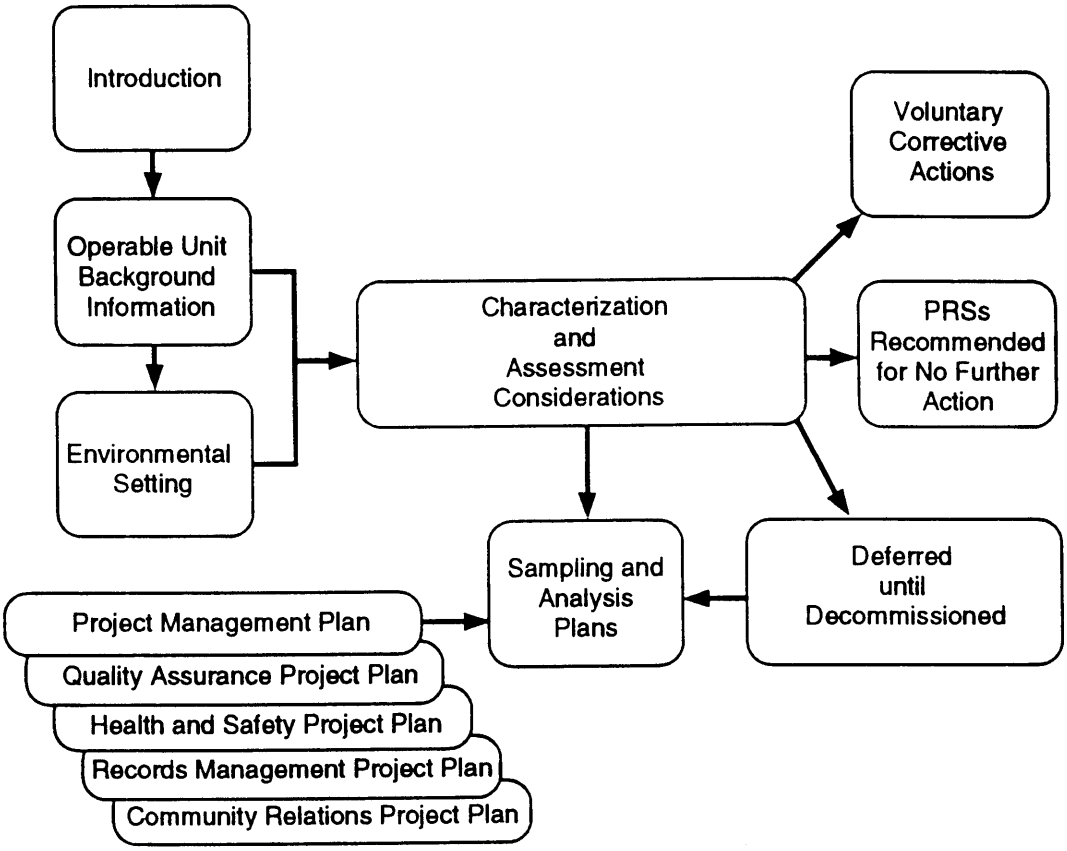
A Department of Energy
Environmental Cleanup Program

FINAL DRAFT

Los Alamos
NATIONAL LABORATORY

LA-UR-92-3968

EXECUTIVE SUMMARY



RFI Work Plan for Operable Unit 1086 Environmental Restoration Program

EXECUTIVE SUMMARY

E.1 Purpose

The primary purpose of this Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) work plan is to determine the nature and extent of releases of hazardous waste or hazardous constituents from potential release sites (PRSs) in Operable Unit (OU) 1086 and to determine the need for corrective measures studies (CMSs). Secondly, this document satisfies part of the regulatory requirements contained in Los Alamos National Laboratory's (the Laboratory's) permit to operate under RCRA. Operable Unit 1086 includes Technical Area (TA) 15. This TA is located in the middle western part of Los Alamos County and is located entirely on Department of Energy (DOE) land.

Module VIII of the permit, known as the HSWA Module [the portion of the permit that responds to the requirements of the Hazardous and Solid Waste Amendments (HSWA)], was issued by the Environmental Protection Agency (EPA) to address potential corrective action requirements for Solid Waste Management Units (SWMUs) at the Laboratory. These permit requirements are addressed by the DOE's Environmental Restoration (ER) Program at the Laboratory. The HSWA Module provides the principal framework for implementing the ER Program at the Laboratory. However, sites to be investigated and evaluated include not only the SWMUs described in the HSWA Module but sites that contain radioactive materials and other substances not addressed by RCRA. The latter sites are called Areas of Concern (AOCs). In this document, SWMUs and AOCs are collectively referred to as PRSs.

The work plan includes sites that are not identified in Module VIII of the permit and are outside the regulatory scope of the permit. These units are included to ensure that all potential environmental problems at each operable unit are investigated and to present to the public and the regulators a unified plan that addresses all potential environmental problems onsite. Inclusion of these sites in the work plan does not confer additional regulatory responsibility or authoirty for these sites to the regulators and deos not bind LANL to additional regulatory responsiblity or authoirty for these sites to the regulators and does not bind LANL to additional commitments outside the scope of the permit. LANL will consider all comments received on this work plan.

This document describes the sampling plans that will be followed to implement the RFI at OU 1086, and, together with nine other work plans submitted to the EPA in 1993 and nine work plans already submitted, meets the requirement set forth in the HSWA Module to address a cumulative percentage of the Laboratory's SWMUs in RFI work plans by August 27, 1993.

E.2 Installation Work Plan

The HSWA Module required the Laboratory to prepare an Installation Work Plan (IWP) to describe the Laboratory-wide system for accomplishing the RFI, corrective measures studies, and corrective measures, a requirement satisfied by the IWP for ER submitted to the EPA in November 1990. That document is updated annually, and the most recent revision was published in November 1992. The IWP identifies the Laboratory's PRSs, describes their aggregation 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 the 1992 version of that document.

Both the IWP and this work plan address radioactive materials and other hazardous substances not subject to RCRA. It is understood that the language in this work plan pertaining to subjects outside the scope of RCRA is not enforceable under the Laboratory's operating permit.

E.3 Background

Landfills, experimental releases from laboratories septic systems, and outfalls are the main types of PRSs, in addition to active and inactive firing sites that are located within OU 1086. Of these, the firing sites are of the greatest concern to potential receptors because they comprise surface PRSs with significant contaminant inventories.

Receptors who are at risk potentially are the current and future occupational workers and future users if the land reverts to the public domain. The most important pathways of contaminants to these receptors are airborne resuspension of hazardous materials and radiation from radioactive materials within the PRSs.

Technical Area-15, also known as R-Site, occupies a portion of Three-Mile Mesa on Pajarito Mesa near the southwestern boundary of the Laboratory. Technical Area-15 occupies approximately 1200 acres. Its boundaries are defined by TA-66 and TA-67 to the north; TA-14, TA-16, TA-37, and TA-49 to the west and south; and TA-36 to the east. Figure EXEC-1 shows the regional location of the Laboratory and Figure EXEC-2 shows the location of TA-15 with respect to other Laboratory TAs, as well as public and private properties surrounding the Laboratory. Figure EXEC-3 identifies the location of PRSs and other salient site features and Figure EXEC-4 identifies the buildings at TA-15. The PRSs are indicated on Figure EXEC-3 by their SWMU or AOC (C) number and are classified both geographically, (10 areas, depending on location) and numerically (depending on the nature of the SWMU). Table EXEC-1 lists the PRSs geographically.

The key to the numerical designation is given below:

001	Storage area
002	Pit
003	Open detonation
004	Inactive firing site
005	Container storage area
006	Active firing site
007	Landfill
008	Surface disposal
009	Active septic system
010	Inactive septic system
011	Sump
012	Operational release
013	Underground tank
014	Outfall

Much of TA-15 has been used from the mid-1940s to the present time for explosives experiments. In that capacity, test explosions ranging from a few kilograms of high explosive to as much as 650 kg were conducted in arrangements that duplicate many of the components of a nuclear weapon, with the exception of the fissionable materials. These components sometimes

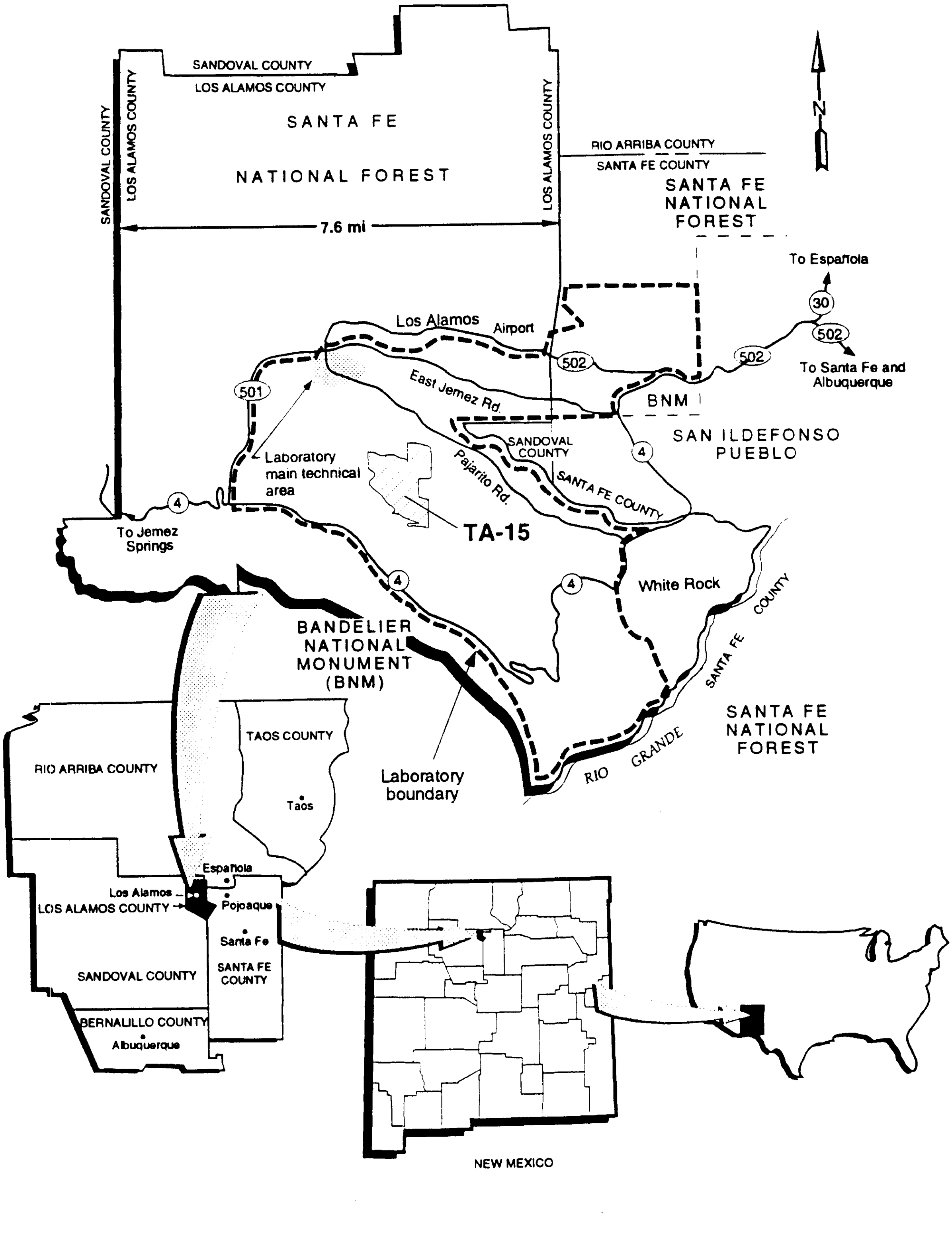


Figure EXEC-1 Regional location of the TA-15 Operable Unit.

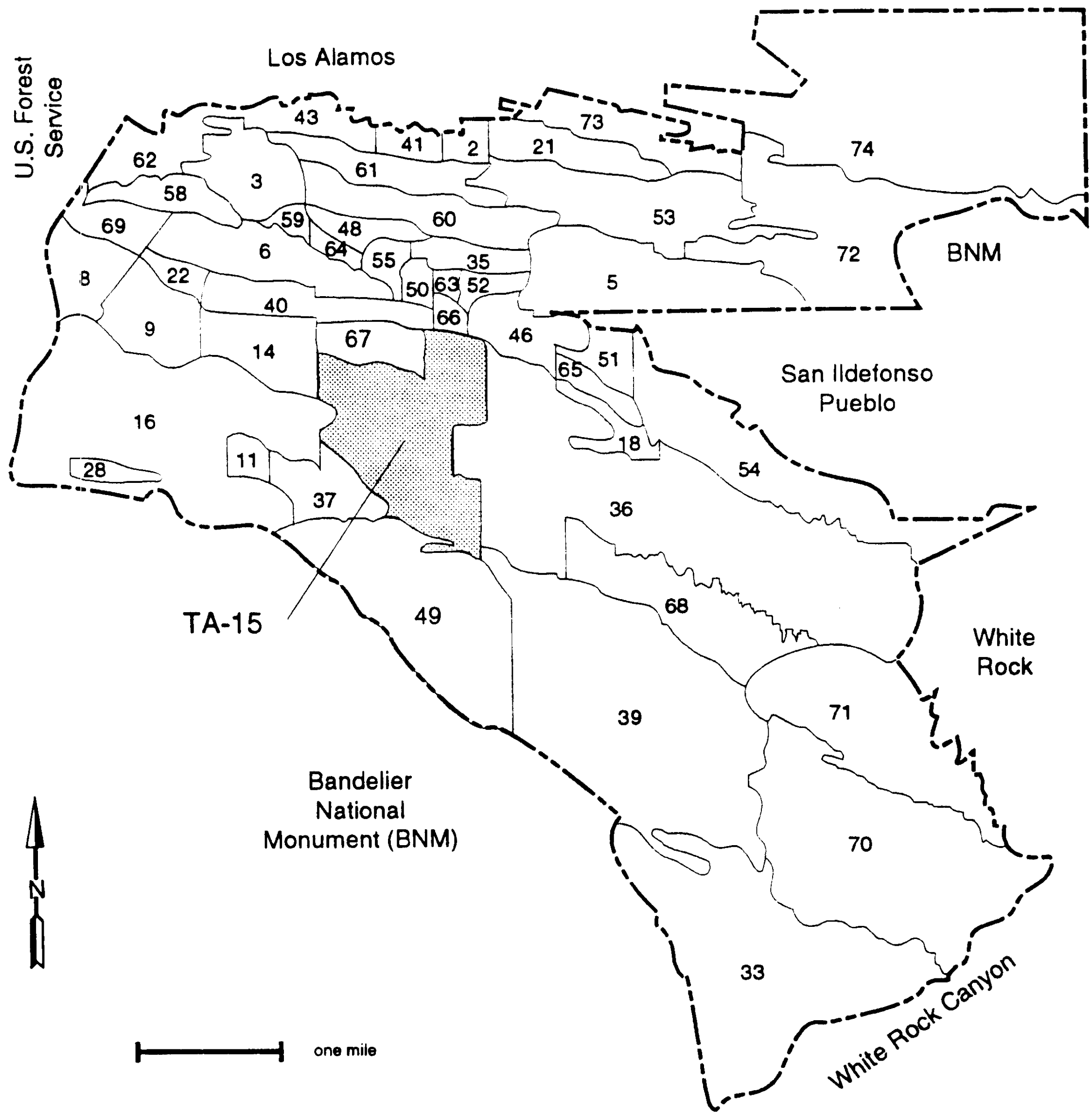


Figure EXEC-2 Location of TA-15 in relation to other TAs and landholdings surrounding the Laboratory.

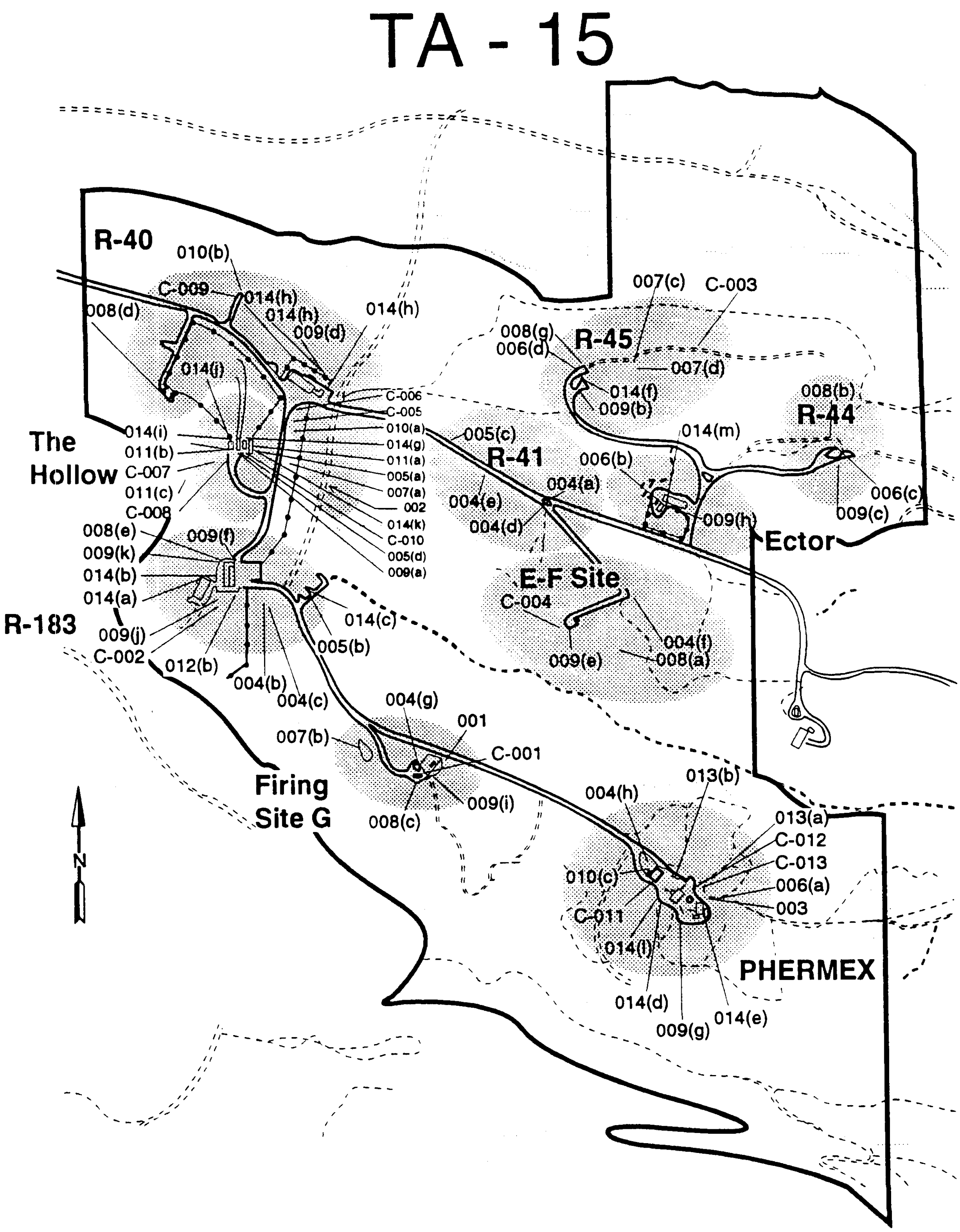


Figure EXEC-3 TA-15 site diagram showing Potential Release Sites (PRSs). Table EXEC-1 lists the PRSs by geographic location and gives the groupings into which the PRSs are placed.

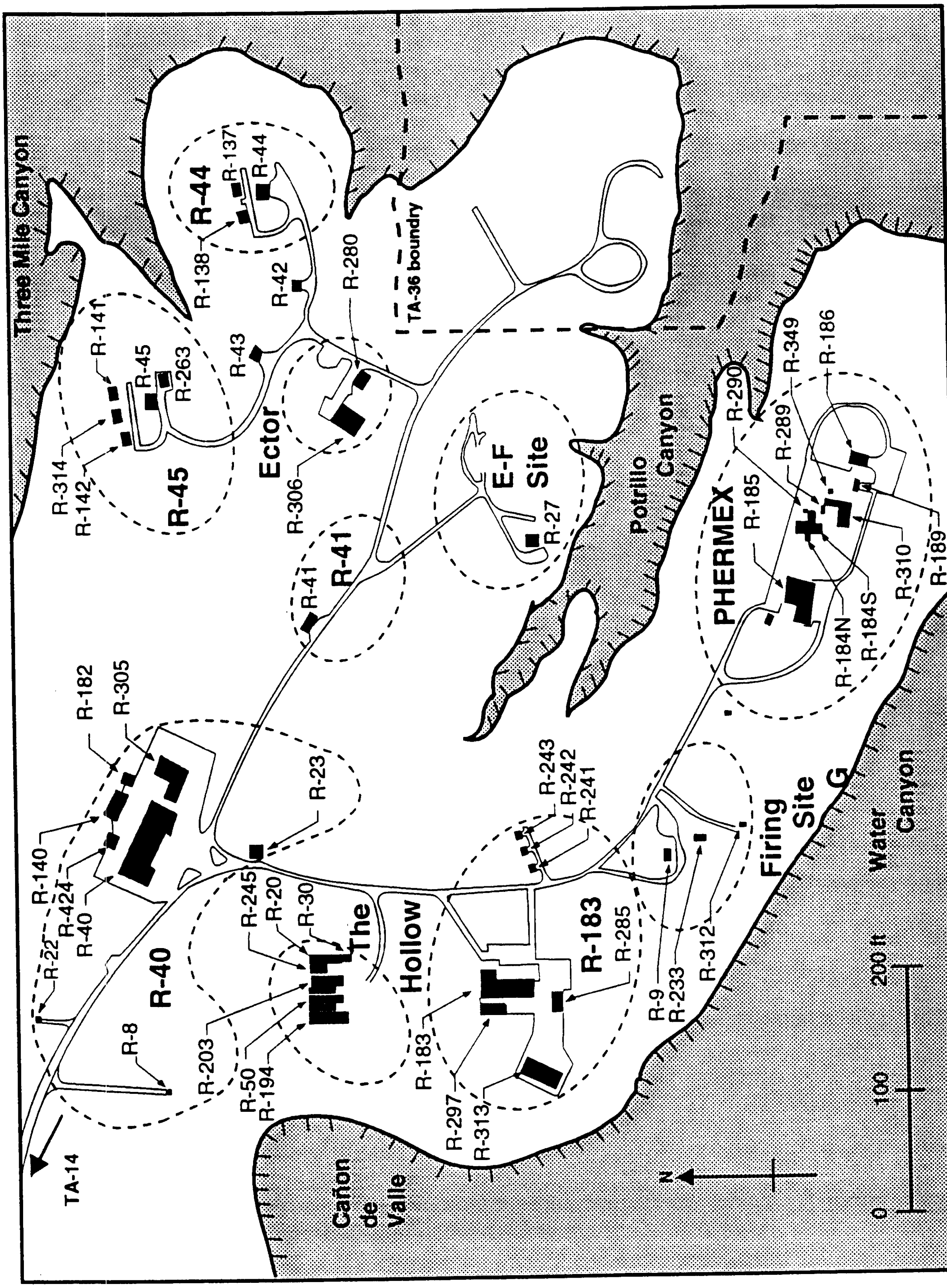


Figure Exec 4 Site map of TA-15 showing building numbers.

TABLE EXEC-1

LOCATION of TA-15 POTENTIAL RELEASE SITES
(Total of 66* SWMUs and 13 AOCS)

LOCATION	SWMU/AOC NO.	DESCRIPTION
Office Buildings, R - 40 and R - 183		
R - 40	15 - 002	Pit
	15 - 007(a)	Landfill
	15 - 008(d)	Surface disposal
	15 - 009(d)	Active septic system
	15 - 010(a), (b)	Inactive septic system
	15 - 014(h)	Outfall
	C - 15 - 005, C - 15 - 006	Site of removed building
	C - 15 - 009	Site of removed tank
R - 183	15 - 004(b), (c)	Inactive firing sites
	15 - 005(b)	Container storage area
	15 - 008(e)	Surface disposal
	15 - 009(f), (k), (j)	Active septic system
	15 - 012(b)	Operational release
	15 - 014(a), (b), (c)	Outfall
	C - 15 - 002	Contaminated soil
Laboratory Complex		
The Hollow	15 - 005(a), (d)	Container storage area
	15 - 009(a)	Active septic system
	15 - 011(a), (b), (c)	Sump
	15 - 014(g), (i), (j), (k)	Outfall
	C - 15 - 007	Stained oil
	C - 15- 008	Site of clear liquid
	C - 15 - 010	Site of removed inactive tank
Inactive Firing Sites		
Firing Site C (R-41)	15 - 004(a), (d), (e)	Inactive firing sites
	15 - 005(c)	Container storage area
E-F Site	15 - 004(f)	Inactive firing sites
	15 - 008(a)	Surface disposal
	15 - 009(e)	Active septic system
	C - 15 - 004	Site of removed transformer station
Firing Site G	15 - 001	Storage area
	15 - 004(g)	Inactive firing site
	15 - 007(b)	Landfill
	15 - 008(c)	Surface disposal
	15 - 009(i)	Active septic system
	C - 15 - 001	Soil pile

TABLE EXEC-1

LOCATION OF TA-15 POTENTIAL RELEASE SITES (*cont.*)
(Total of 66* SWMUs and 13 AOC)

LOCATION	SUMU/AOC NO.	DESCRIPTION
Active Firing Sites		
PHERMEX	15 - 003	Burn pad
	15 - 004 (h)	Inactive firing Site
	15 - 006 (a)	Active firing site
	15 - 009 (g)	Active firing site
	15 - 010 (c)	Inactive septic system
	15 - 013 (a), (b)	Underground tank
	15 - 014 (e), (d), (l)	Outfall
	C - 15 - 011	Inactive underground storage tank (UST)
	C - 15 - 012	Active (UST)
	C - 15 - 013	Inactive (UST)
Ector	15 - 006 (b)	Active firing sites
	15 - 009 (h)	Active septic system
	15 - 014 (m)	Outfall
R - 44	15 - 006 (c)	Active firing site
	15 - 008 (b)	Surface disposal
	15 - 009 (c)	Active septic system
R - 45	15 - 006 (d)	Active firing site
	15 - 007 (c), (d)	Landfill
	15 - 008 (g)	Surface disposal
	15 - 009 (b)	Active septic system
	15 - 014 (f)	Outfall
	C - 15 - 003	Black granular material

***of these 66 SWMUs, four are not shown:** 15 - 006 (e) and 15 - 008 (f) were transferred to TA - 36, 15 - 004 (i) and 15 - 012 (a) were never located contained multi-kilogram quantities of natural uranium metal, depleted uranium metal, and lesser quantities of beryllium and other metals. In most cases, the tests were carried out aboveground, which resulted in the test materials being scattered over areas with radii up to several hundreds of meters. Based on Laboratory records, some 75 metric tons of natural and depleted uranium have been expended at the firing sites on TA-15 since the mid-1940s.

E.4 Technical Approach

For the purposes of describing and implementing the sampling and analysis plans described in this work plan, most PRSs are grouped into aggregates. This work plan presents the description and operating history of each PRS and aggregates, together with an evaluation of the existing data, if any, in order to develop a preliminary conceptual exposure model for the site. For some sites, no further action can be proposed on the basis of this review; these sites are discussed in Chapter 5. For other sites, this review is sufficient to determine that investigation and remediation (if required) may be deferred until the site is decommissioned; these sites are discussed in Chapter 6. The remaining sites, for which RFI work is proposed, are discussed in Chapters 7 through 10.

The technical approach to field sampling followed in this work plan is designed to refine the conceptual exposure models for the PRSs and aggregates to a level of detail sufficient for preliminary risk assessment and the evaluation of remedial alternatives (including voluntary corrective actions). A phased approach to the RFI is used to ensure that any environmental impacts associated with past and present activities are investigated in a manner that is both cost-effective and complies with the HSWA Module. This phased approach permits intermediate data evaluation, with opportunities for additional sampling, if required.

For PRSs for which there is no existing data and little or no historical evidence that a release has occurred, the Phase I sampling strategy for OU 1086 will focus on determining the presence or absence of hazardous and radioactive contaminants. If contaminants are detected at concentrations above screening action levels (SALs) based on a screening assessment, a voluntary corrective action (VCA) may be proposed. The goal of screening assessments is to identify contaminants of concern (COCs) that is, constituents whose concentration levels in one or more environmental media are above a level of concern defined by media-specific SALs. Although the derivation of SALs is frequently based on risk calculations, these calculations use very conservative assumptions. Baseline risk assessments, on the other hand, use site-specific land-use scenarios and exposure assumptions for the individual with reasonable maximum exposure to estimate the risks associated with the observed contaminants of concern (COCs). If the data collected during Phase I are insufficient to support a VCA based on screening assessment, additional RFI Phase II sampling will be undertaken to characterize in more detail the nature and extent of the release, and to provide data for baseline risk assessments and corrective measure studies.

For some PRSs in OU 1086, it is known that a release has occurred. In these cases, the existing information has been evaluated to compare it to the SALs as they are developed and/or the evaluation of remedial alternatives, which would be utilized in a VCA. Phase I investigation for these sites will collect data as required to identify the presence of COCs and to refine the site conceptual exposure model for these purposes.

Data quality objectives to support the required decisions are developed for RFI Phase I sampling and analysis plans described in this work plan to ensure that the right type, amount, and quality of data are collected. Field work for many sites includes 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. Quality assurance samples will constitute an additional body of samples to those being submitted for analysis in fixed analytical laboratories. Table EXEC-2 shows a summary of all sampling plans for OU 1086. It presents an estimate of the total number of field screening analyses and laboratory analyses (the latter being subject to wide changes from initial estimates depending on the field screening analyses).

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

In addition to the annexes, there are also 9 appendices which provide ancillary information for OU 1086. These include maps (site and soils), field and laboratory investigation methods, engineering drawings, National Environmental Policy Act (NEPA) documentation, heatlh risk assessment for PHERMEX, radiological survey methods, aerial radiological survey and a list of work plan contributors.

E.5 Schedule, Costs, and Reports

The RFI field work described in this document requires 3 yr. (Figure EXEC-5) to complete Phase I: two years for field work and one year for completing laboratory analysis, evaluation and phased reports, (Figure EXEC-6). A single phase of field work is expected to be sufficient to complete the RFI for most PRSs, However, a second phase will occur if warranted by the results of the first phase, in which case the field work probably will take longer than 5 yr (Phase I and Phase II) to complete.

Cost and scheduling estimates for baseline activities for OU 1086 are provided in Figure EXEC-7. The total estimated cost for the corrective action process at OU 1086 is approximately $24.8 million (without escalation).

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

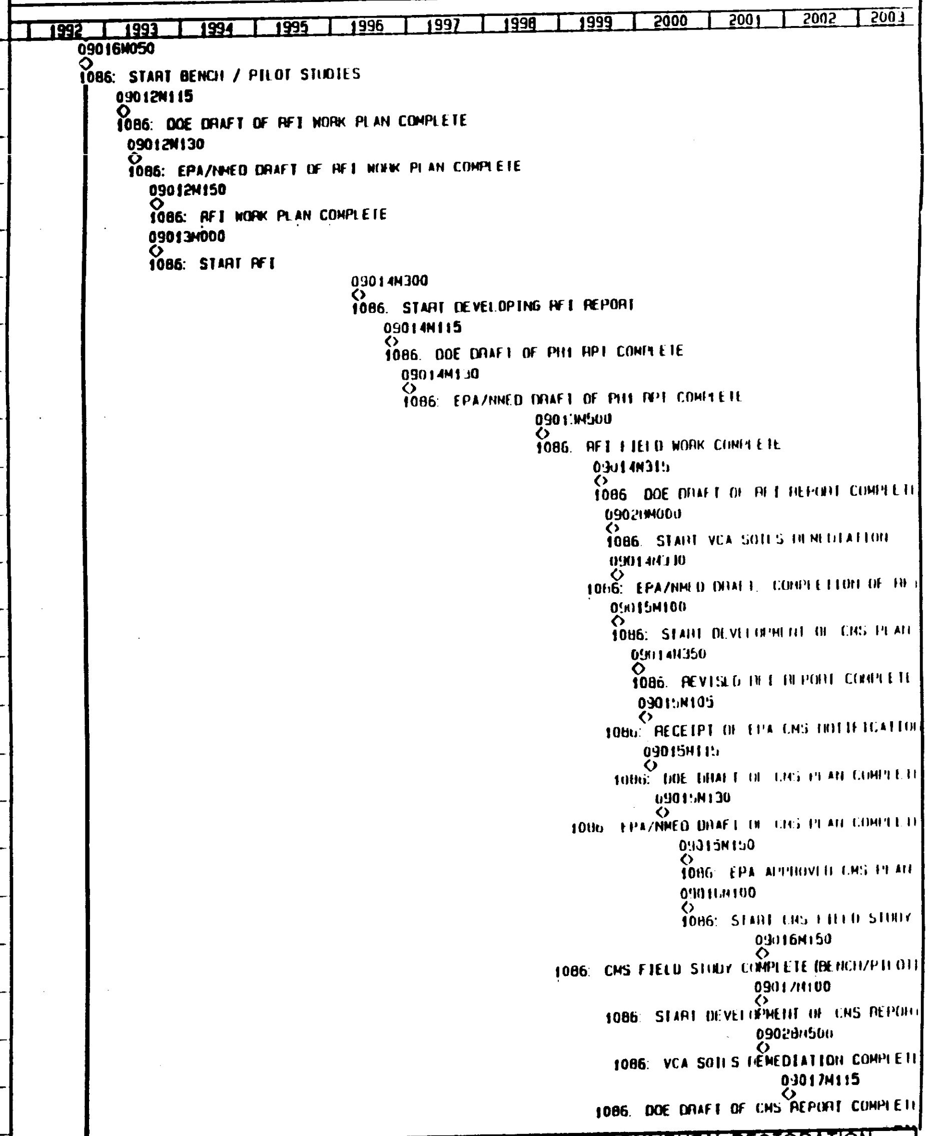
E.6 Public Involvement

Regulations issued pursuant to HSWA mandate public involvement in the corrective action process. In addition, the Laboratory is providing a variety of opportunities for public involvement, including meetings held as needed to disseminate information, to discuss significant milestones, and to solicit informal public review of this and the other draft work plans. The Laboratory also

**TABLE EXEC-2
SUMMARY OF SAMPLING PLANS AND PROJECTED NUMBER OF ANALYSES**

TABLE	PRS NUMBERS	FIELD SCREENING											LABORATORY ANALYSIS										
		Alpha, Beta, Gamma	Uranium	Thorium	Silver	Beryllium	Lead	Mercury	Chromium	HEs	PCBs	VOCs	Uranium	Thorium	Silver	Beryllium	Lead	Mercury	Chromium	HEs	PCBs	VOCs	SVOCs
7.3-2	15-004 (f), 15-008 (a) 15-009 (e), C 15-004	116	116			116	116	61		40	2	2	27			27	27	27		2	2	2	2
8.3-1	15-004 (b), 15-004 (c)	18	18			18	18			18			8			8	8						
8.4-1	15-004 (a), 15-004 (d)	18	18			18	18			18			8			8	8						
8.5-1	15-004 (g), 15-001, 15-009(l) 15-008 (c), C 15-001	27	27			27	27			27		2	17			17	17			2		2	2
8.6-1	15-004 (h), 15-010 (c), C 15-011	24	26		2	26	26		2	24		4	14		2	14	14		2			4	4
8.7-1	15-002	4	4			4	4			4		2	4			4	4					2	4
9.1-1	15-007 (a), C 15-005, C 15-006	20	20	20	20	20	20	20		14		10	12	12	12	12	12	12				6	12
9.2-1	15-007 (b)	28	28			28	28	28		28		14	14			14	14	14				7	14
9.3-1	15-008 (b)	10	10			10	10			10			4			4	4						
10.1-1	15-011 (a), (b), (c), C 15-010 15-014(l), (j), (h), C 15-007	14	14			14	14		14	4		10	14			14	14		14			10	14
10.2-1	15-012 (b), 009 (j)	14	14			14	14			14			8			8	8			2			
10.2-3	15-014 (a), (b), 15-009 (f), (k), 15-005 (b), (c)	8	8		12	8	8			8		6	8		12	8	8			4		6	12
10.3-1	15-014 (h), 15-010 (b)				4					4		4			2					4		2	2
TOTAL		301	303	20	38	303	303	109	16	213	2	54	138	12	28	138	138	53	16	14	2	41	66

ACTIVITY ID	ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
09016M050	1086: START BENCH / PILOT STUDIES	1OCT92	
09012M115	1086: DOE DRAFT OF RFI WORK PLAN COMPLETE		2APR93
09012M130	1086: EPA/NMED DRAFT OF RFI WORK PLAN COMPLETE		28MAY93
09012M150	1086: RFI WORK PLAN COMPLETE		14SEP93
09013M000	1086: START RFI	15SEP93	
09014M300	1086: START DEVELOPING RFI REPORT	31MAY96	
09014M115	1086: DOE DRAFT OF PH1 RPT COMPLETE		5NOV96
09014M130	1086: EPA/NMED DRAFT OF PH1 RPT COMPLETE		27JAN97
09013M500	1086: RFI FIELD WORK COMPLETE		27OCT98
09014M315	1086: DOE DRAFT OF RFI REPORT COMPLETE		5AUG99
09028M000	1086: START VCA SOILS REMEDIATION	1OCT99	
09014M330	1086: EPA/NMED DRAFT: COMPLETION OF RFI		20OCT99
09015M100	1086: START DEVELOPMENT OF CMS PLAN	21OCT99	
09014M350	1086: REVISED RFI REPORT COMPLETE		27JAN00
09015M105	1086: RECEIPT OF EPA CMS NOTIFICATION		28FEB00
09015M115	1086: DOE DRAFT OF CMS PLAN COMPLETE		24MAR00
09015M130	1086: EPA/NMED DRAFT OF CMS PLAN COMPLETE		22MAY00
09015M150	1086: EPA APPROVED CMS PLAN		13SEP00
09016M100	1086: START CMS FIELD STUDY	14SEP00	
09016M150	1086: CMS FIELD STUDY COMPLETE (BENCH/PILOT)		13SEP01
09017M100	1086: START DEVELOPMENT OF CMS REPORT	14SEP01	
09028M500	1086: VCA SOILS REMEDIATION COMPLETE		28SEP01
09017M115	1086: DOE DRAFT OF CMS REPORT COMPLETE		29JAN02



Plot Date	9DEC92	Activity Bar/Early Dates	
Data Date	1OCT92	Critical Activity	
Project Start	1OCT91	Progress Bar	
Project Finish	30SEP03	Milestone/Flag Activity	

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3Z86 — Sheet 1 of 2

LANL INC-9 — C. MASON

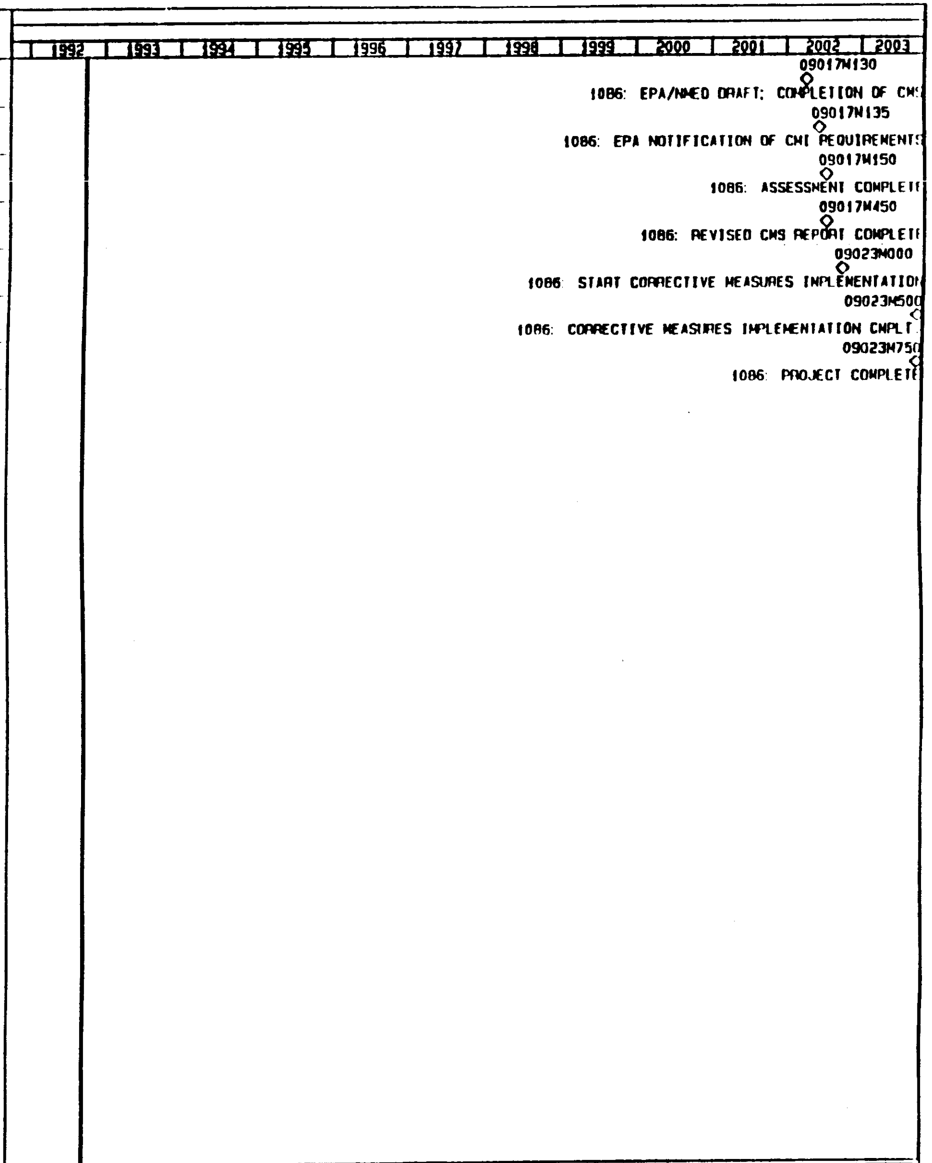
ADS 1086:TA-15 — FY93 BASELINE

MILESTONE BAR CHART

ENVIRONMENTAL RESTORATION			
Date	Revision	Checked	Approved

Figure EXEC-5 TA-15 Operable Unit (Activity Data Sheet 1086) RCRA Facility Investigation/Corrective Measures Study.

ACTIVITY ID	ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
09017M130	1086 EPA/NMED DRAFT; COMPLETION OF CMS		12APR02
09017M135	1086 EPA NOTIFICATION OF CMI REQUIREMENTS		14JUN02
09017M150	1086 ASSESSMENT COMPLETE		15JUL02
09017M450	1086 REVISED CMS REPORT COMPLETE		15JUL02
09023M000	1086 START CORRECTIVE MEASURES IMPLEMENTATION	1OCT02	
09023M500	1086 CORRECTIVE MEASURES IMPLEMENTATION CMPLT		30SEP03
09023M750	1086 PROJECT COMPLETE		30SEP03



Plot Date	9DEC92	Activity Bar/Early Dates	
Data Date	1OCT92	Critical Activity	
Project Start	1OCT91	Progress Bar	
Project Finish	30SEP03	Milestone/Flag Activity	
(c) Primavera Systems, Inc.			

3Z86 Sheet 2 of 2
LANL INC-9 C. MASON
ADS 1086:TA-15 FY93 BASELINE
MILESTONE BAR CHART

ENVIRONMENTAL RESTORATION			
Date	Revision	Checked	Approved

Figure EXEC-5 (*Cont.*) TA-15 Operable Unit (Activity Data Sheet 1086) RCRA Facility Investigation/Corrective Measures Study.

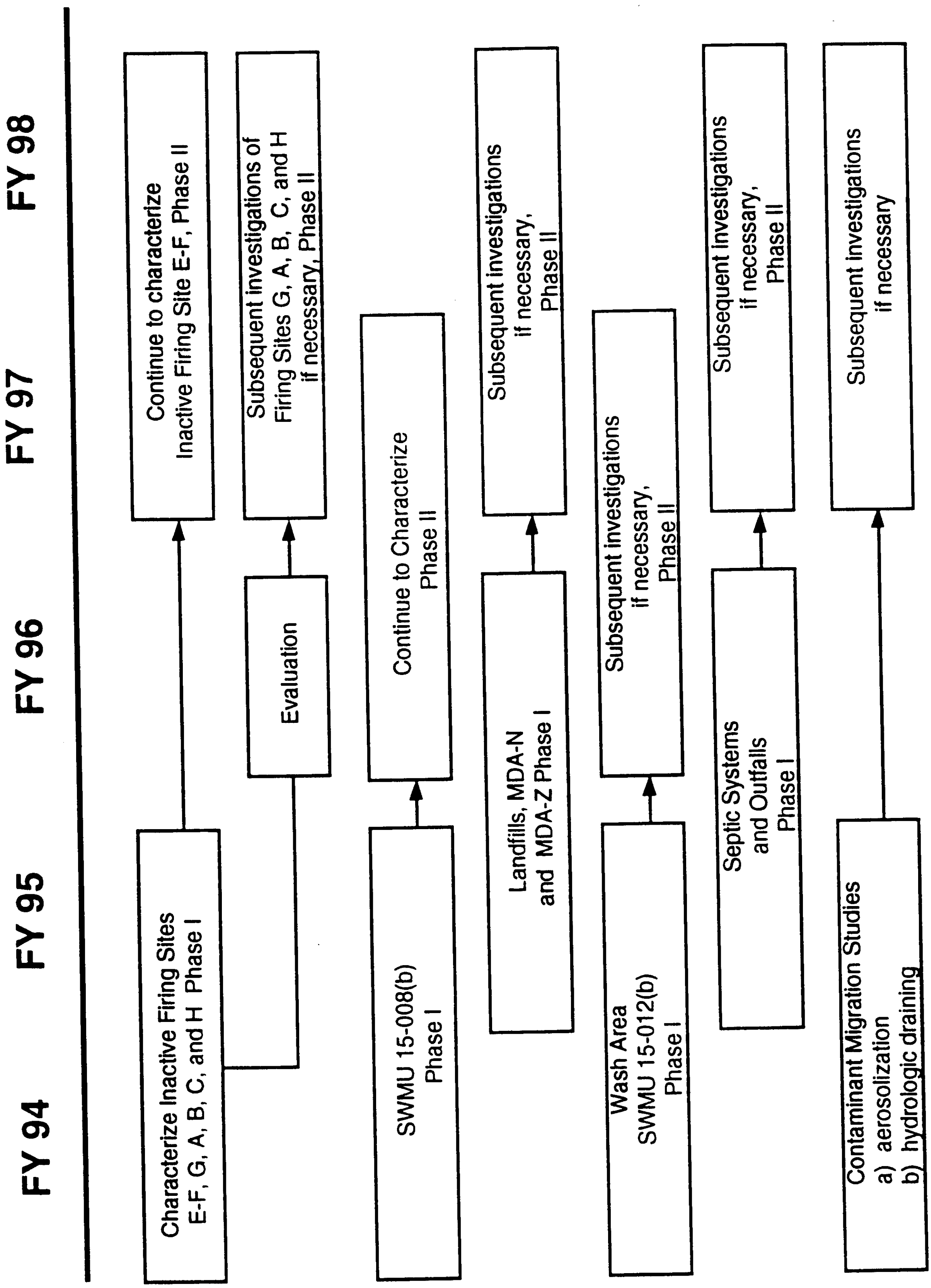


Figure EXEC-6 Logic flow of the OU 1086 RFI(also Figure I.1-1).

LANL INC-7 C.MASON — FINEST HOUR — ADS 1086: TA-15

REPORT DATE 24MAY93 RUN NO. 90 17:12 — ENVIRONMENTAL RESTORATION — START DATE 1OCT91 FIN DATE 30SE

FY93 MILESTONE REPORT — DATA DATE 1OCT92 PAGE NO.

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
09012M130	0	0	0	1086: EPA/NMED DRAFT OF RFI WORK PLAN COMPLETE	.00	.00		28MAY93
09014M130	0	0	0	1086: EPA/NMED DRAFT OF PH1 RPT COMPLETE	.00	.00		27JAN97
09014M330	0	0	0	1086: EPA/NMED DRAFT; COMPLETION OF RFI	.00	.00		20OCT99
09015M105	0	0	0	1086: RECEIPT OF EPA CMS NOTIFICATION	.00	.00		28FEB00
09015M130	0	0	0	1086: EPA/NMED DRAFT OF CMS PLAN COMPLETE	.00	.00		22MAY00
09015M150	0	0	0	1086: EPA APPROVED CMS PLAN	.00	.00		13SEP00
09017M130	0	0	0	1086: EPA/NMED DRAFT; COMPLETION OF CMS	.00	.00		12APR02
09017M135	0	0	0	1086: EPA NOTIFICATION OF CMI REQUIREMENTS	.00	.00		14JUN02
REPORT TOTAL					.00	.00		

$ x 1000

Estimate to Complete	**$19,890**
Escalation	**$4,333**
Prior Years	**$601**
Total at Completion	**$24,824**

FIGURE EXEC-7 Costing and Scheduling Estimates for Baseline Activities for OU 1086 distributes meeting notices and updates the ER Program mailing list; prepares fact sheets summarizing completed and future activities; and provides public access to plans, reports, and other ER Program documents. These materials are available for public review between 9:00 a.m. and 4:00 p.m. on Laboratory business days at the ER Program's public reading room at 1450 Central Avenue, Suite 101, in Los Alamos and at the main branches of the public libraries in Española, Los Alamos, and Santa Fe.

5.0 SOLID WASTE MANAGEMENT UNITS RECOMMENDED FOR NO FURTHER ACTION

6.0 SOLID WASTE MANAGEMENT UNITS TO BE DEFERRED FOR ACTION UNTIL DECOMMISSIONED

8.0 INACTIVE FIRING SITES AND RELATED UNITS

9.0 SAMPLING AND ANALYSIS PLANS FOR LANDFILLS AND RELATED AREAS

10.0 MISCELLANEOUS POTENTIAL RELEASE SITES

11.0 TRANSFER TO OTHER OPERABLE UNITS

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LIST OF ACRONYMS AND ABBREVATIONS

AA	Atomic absorption
ACGIH	American Conference of Governmental Industrial Hygienists
ADS	Activity Data Sheet
ALARA	as low as reasonably achievable
ANL	Argonne National Laboratory
AOC	Area of Concern
ASTM	American Society for Testing and Materials
Be	Beryllium
BRET	Biological Resource Evaluation Team
BNM	Bandelier National Monument
CEARP	Comprehensive Environmental Assessment and Response Program
CEDE	committed effective dose equivalent
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Ci	Curie
CLP	Contract Laboratory Program
CMS	Corrective Measures Study
COC	contaminant of concern
D&D	decontamination and decommissioning
DAHRT	Dual-Axis Hydrodynamics Radiographic Test (facility)
DEC	DOE Environmental Checklist
DECOM	computer codes for remediation
DECHEM	computer code for remediation

DOE	Department of Energy
DOE/AL	US Department of Energy Albuquerque Operations Office
DQO	data quality objective
DU	depleted uranium
EDE	effective dose equivalent
EID	Environmental Improvement Division (New Mexico state)
EM	Environmental Management (Division)
EPA	Environmental Protection Agency
ER	environmental restoration
ERIA	Environmental Restoration Interim Action
ES&H	Environmental Safety and Health
ESG	Environmental Surveillance Group
FIDLER	field instrument for detection of low-energy radiation
FIMAD	Facility for Information Management, Analysis, and Display
FSP	Field Sampling Plan
ft	Foot
FY	Fiscal Year
gal	gallon
GC	gas chromatography
GET	General Employee Training
H&S	Health and Safety
HAZWOP	Hazardous Waste Operations Program
HE	high explosive
Hg	Mercury
HPLC	high-performance liquid chromatography
HRD	Health Research Division

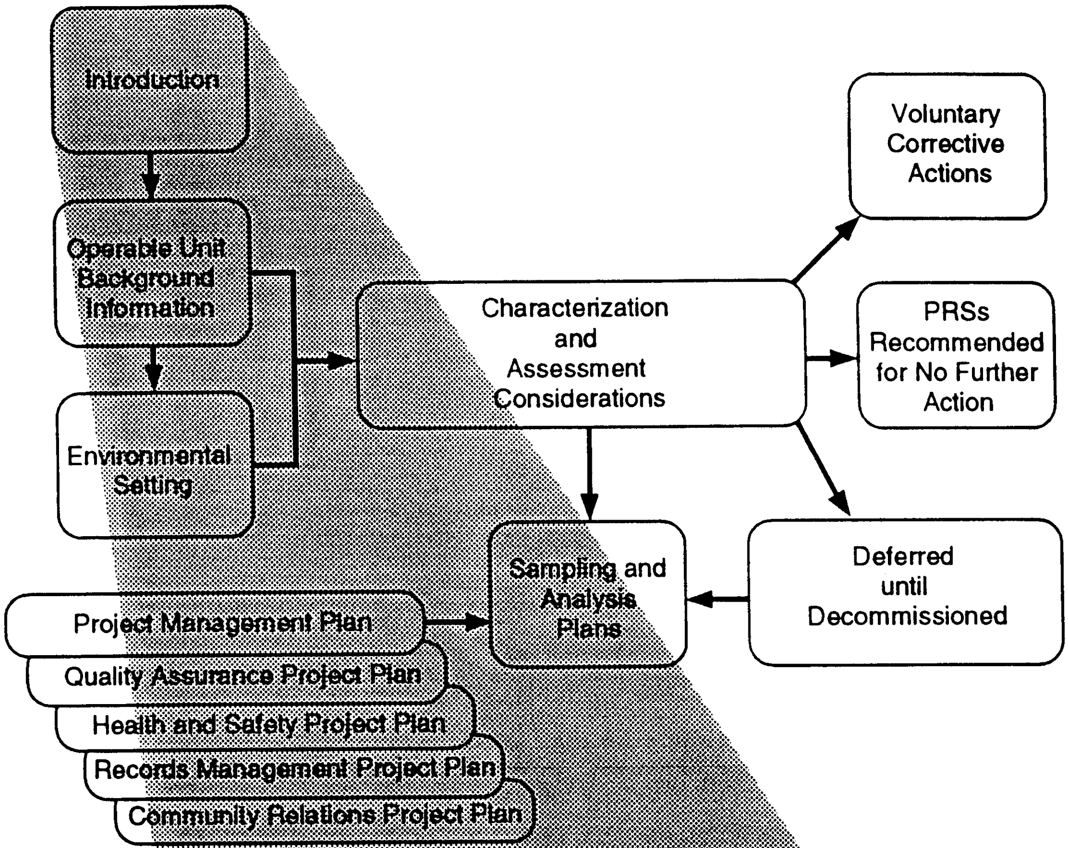
HRS	Hazard Ranking System
HS	Health and Safety (Division)
HSPL	Health and Safety Project Leader
HSWA	Hazardous and Solid Waste Amendments
IA	interim action
ICP	inductively coupled plasma mass spectometry
ICPMS	inductively coupled plasma-mass spectroscopy
in	inch
INC	Isotope and Nuclear Chemistry (Division)
INEL	Idaho National Engineering Laboratory
IWP	Installation Work Plan
IWPHSPP	Installation Work Plan Health and Safety Program Plan
kg	kilogram
km	kilometers
kV	kilovolts
LANL	Los Alamos National Laboratory
LASL	Los Alamos Scientific Laboratory
m	meter
M	Dynamic Testing (Division)
mCi	microcurie
MDA	Material Disposal Area
MDL	minimum detection limit
µg	microgram
mg	milligram
MOU	memorandum of understanding
MS	mass spectrometry
NAA	neutron activation analysis

NaI	sodium iodide
NEPA	National Environmental Policy Act
NFA	no further action
NMED	New Mexico Environment Division
NPDES	National Pollutant Discharge Elimination System
NRDA	Natural Resource Damage Assessment
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
OU	operable unit
OUHSP	Operable Unit Health and Safety Plan
OUPL	Operable Unit Project Leader
OVA	organic vapor analyzer
PARCC	precision, accuracy, representativeness, completeness, and comparability
Pb	lead
PCB	polychlorinated biphenyl
pCi	picocurie
PEL	permissible exposure limits
PHERMEX	Pulsed, High-Energy, Radiographic Machine Emitting X-rays (facility)
PID	photoionization detector
PL	Project Leader
PM	Program Manager
PMP	Program Management Plan
PPE	Personal Protective Equipment
ppm	parts per million
PQL	practical quantitation limit

PRS	potential release site
QA	quality assurance
QAPjP	Quality Asurance Project Plan
QC	quality control
QPP	Quality Program Plan
QPPL	quality program project leader
RCRA	Resource Conservation and Recovery Act
RESRAD	residual radioactive material (code)
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RI	remedial investigation
RI/FS	Remedial Investigation/Feasibility Study
RMP	Records Management Plan
RPF	Records Processing Facility
RPS	radiation protection standard
SAL	screening action level
SAP	Sampling and Analysis Plan
SHPO	State Historic Preservation Officer
SOP	standard operating procedure
SSHSP	Site-Specific Health and Safety Plan
SSO	Site Safety Officer
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
SWSC	Sanitary Wastewater System Consolidation
TA	technical area
TAL	target analyte list
TCL	target compound list

TCLP	toxicity characteristic leaching procedure
TDS	total dissolved solids
TLD	thermoluminescent dosimeter
TLV	threshold limit value
TCLP	toxicity characteristic leaching procedure
TRU	transuranic
U	uranium
UC	University of California
UST	underground storage tank
VCA/IA	voluntary corrective action/interim action
VOC	volatile organic compound
WBS	work breakdown structure
WP	work plan
XRF	X-ray fluorescence
yr	year

CHAPTER 1



Introduction

- Overview
- HSWA Requirements
- Work Plan Organization
- Operable Unit Description

1.0 INTRODUCTION

1.1 Overview of the Environmental Restoration Program

In March 1987, the Department of Energy (DOE) established a nationwide Environmental Restoration (ER) Program to address environmental cleanup requirements at its facilities. Los Alamos National Laboratory (LANL) (the Laboratory) is operated for the DOE by the University of California (UC) and is subject to the DOE's ER Program.

The Laboratory's operational requirements, outlined in the Resource Conservation and Recovery Act (RCRA) operating permit, are implemented by the Laboratory's ER Program. In particular, the Hazardous and Solid Waste Amendments (HSWA) Module VIII issued by the Environmental Protection Agency (EPA) gives specific requirements affecting the conduct of the ER Program (EPA 1990, 0306). The HSWA Module became effective on May 23, 1990. The Laboratory's ER Program also is consistent with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (DOE 1989, 0078).

The HSWA Module provides the principal framework for implementing the ER Program at the Laboratory. However, sites to be investigated and evaluated include not only the solid waste management units (SWMUs) described in the HSWA Module but sites that may contain radioactive materials and other substances not addressed by RCRA. The latter sites are called areas of concern (AOCs). In this document, SWMUs and AOCs are collectively referred to as potential release sites (PRSs).

The HSWA Module requires the Laboratory to prepare an installation-wide work plan to contain the programmatic elements of a RCRA Facility Investigation (RFI) work plan. This requirement was satisfied by a Laboratory-wide Installation Work Plan (IWP) submitted to the EPA on November 19, 1990 (LANL 1990a, 0144). The IWP, which is updated annually, serves as the plan by which DOE/UC will conduct the ER Program at the Laboratory. The IWP describes the ER Program and its history at the Laboratory; provides an installation-wide description of current conditions; identifies the Laboratory's SWMUs and AOCs, (these together comprise PRSs and their aggregation into a number of operable units (OUs); and presents the Laboratory's overall management and technical approach for meeting the requirements of the HSWA Module. The IWP is the document to which individual OU work plans are tiered. Relevant information presented in the IWP will be referenced but in general not repeated in OU work plans.

1.2 Hazardous and Solid Waste Amendments Requirements

The HSWA Module also requires the Laboratory to prepare OU RFI work plans for specific investigations. The Technical Area 15 (TA-15) work plan is one of 24 OU work plans to be prepared. Within the ER Program, the TA-15 assessment task is identified as Activity Data Sheet (ADS) 1086 and the OU is referenced as OU 1086. Additional information regarding the Laboratory's ER Program, its implementation, and the guidance under which the TA-15 work plan was prepared is given in Chapter 3 of the 1991 IWP.

The OU 1086 work plan addresses 5.0% of the Laboratory's SWMUs listed in Table A of the HSWA Module of the Laboratory's Part B Operating Permit and includes 9.8% of the SWMUs appearing on the HSWA Module Table B list of priority SWMUs. The OU 1086 work plan thus contributes to the Laboratory's commitment to address 55% of Table A SWMUs and 100% of Table B SWMUs by May 23, 1993, as required by the HSWA Module.

The November 1990 Laboratory SWMU report (LANL 1990b, 0145) and Appendix G of the 1990 IWP lists 66 OU 1086 SWMUs that are subdivided into 15 SWMU subunits, of which only 30 of the individual SWMUs are listed in the May 1990 HSWA Module. Although not required by the HSWA Permit, all of the 66 OU 1086 SWMUs are addressed in this work plan. The HSWA Module Table A lists 18 SWMUs as priorities: 15-002, 15-006 (a–d), 15-007 (a–d), 15-008 (a–g), 15-009 (a–k), 15-012 (a–g). In the 1990 SWMU report some of these SWMU numbers have been changed, so that the current priority (Table B) SWMU listing is 15-002, 15-006 (a–d), 15-008 (a–d), 15-009 (a–b), 15-012 (a–b), 15-014 (i–m). This second listing is used throughout this RFI Work Plan. AOCs were also listed for TA-15 in the 1990 SWMU report. No new SWMUs or AOCs were identified during the preparation of the work plan, although the locations of some SWMUs were better identified.

When EPA approves the OU work plan, the Laboratory will prepare a Class III Permit Modification Application to remove the SWMUs to which EPA has agreed that NFA is appropriate.

Table 1.2.-1 summarizes the designations of the PRSs from the Laboratory 1990 SWMU report. The PRSs on this table are divided into the groupings of the Laboratory's SWMU report. In addition, the chapters are noted in which each PRS is considered in this work plan.Table 1.2-2 lists the SWMUs with alternative past identification schemes from the DOE Comprehensive Environmental Assessment and Response Program (DOE 1987, 0264).

The present work plan for OU 1086 is organized in a somewhat different fashion from the order given in Table 1.2-1. The chapters are organized according to the characterization activities planned for the PRS, as follows:

- Chapter 5 — No further action required
- Chapter 6 — Action deferred until decommissioned, Active Firing Sites
- Chapter 7 — Inactive firing site, E-F, Sampling plan
- Chapter 8 — Other inactive firing sites with sampling plans
- Chapter 9 — Landfills with sampling plans
- Chapter 10 — Miscellaneous PRSs with sampling plans
- Chapter 11 — SWMUs transferred to other OUs

TABLE 1.2-1
INVESTIGATION GROUPS AND DESIGNATIONS

Group	Work Plan Chapter	Current SWMU No.	EPA Priority A, B	Description	Comprehensive Environmental Assessment and Response Program (CEARP) I.D. No.	RFA Unit EID No. EPA No.	ER Release Site Info.: Task No.
BONEYARD							
	8	15-001		Storage area			
PIT							
	8	15-002	A, B	U Burning	TA15-4-CA-I-HW/RW	15.009	
OPEN DETONATION							
	6	15-003	A	Burn Pad	TA15-12-CA-A-HW/RW	15.003	23:1645
FIRING SITE (INACTIVE)							
Point C	8	15-004(a)		Firing platforms	TA15-1-CA-I-HW/RW	15.014	23:1632 1633
Point A	8	15-004(b)		Firing site	TA15-1-CA-I-HW/RW	15.014	22:1534 1536 1537 1544 1549
Point B	8	15-004(c)		Firing site	TA15-1-CA-I-HW/RW	15.014	22:1534 1550
Point C	8	15-004(d)		Firing site	TA15-1-CA-I-HW/RW	15.014	23:1635
Point D	5	15-004(e)	A	Firing site	TA15-1-CA-I-HW/RW	15.014	23:1636
Point E-F	7	15-004(f)		Firing site	TA15-1-CA-I-HW/RW	15.017	23:1637
Point G	8	15-004(g)		Firing site	TA15-1-CA-I-HW/RW	15.014	22:1538 1551 1552
Point H	8	15-004(h)		Firing site	TA15-1-CA-I-HW/RW	15.014	23:1641
Unlocated	5	15-004(i)		The "Gulch"	TA15-1-CA-I-HW/RW	15.014	23:1634
CONTAINER STORAGE AREA							
	5	15-005(a)		Storage rooms			24:1592
	10	15-005(b)		High explosive storage	TA15-13-CA-A-HW	15.014	
	10	15-005(c)		Storage	TA15-13-CA-A-HW	15.014	23:1629
	5	15-005(d)		Storage			24:1591
FIRING SITE (ACTIVE)							
PHERMEX	6	15-006(a)	A, B	Firing site	TA15-2-CA-A-HW/RW	15.013	23:1643
Ector	6	15-006(b)	A, B	Firing site	TA15-2-CA-A-HW/RW	15.007	23:1642
R44	6	15-006(c)	A, B	Firing site	TA15-1-CA-I-HW/RW	15.006	23:1639
R45	6	15-006(d)	A, B	Firing site	TA15-1-CA-I-HW/RW	15.014	23:1640
Point I-J	11	15-006(e)		Firing site			23:1628

TABLE 1.2-1 (*Cont.*)
INVESTIGATION GROUPS AND DESIGNATIONS

Group	Work Plan Chapter	Current SWMU No.	EPA Priority A, B	Description	Comprehensive Environmental Assessment and Response Program (CEARP) I.D. No.	RFA Unit EID No. EPA No.	ER Release Site Info. Task No.
LANDFILL							
MDA-N	9	15-007(a)	A	Shallow landfill		15.001	24:1595 1597
MDA-Z	9	15-007(b)	A	Shallow landfill		15.012	24:1596 1598
Shafts	5	15-007(c)	A	Drilled shaft	TA15-3-CA-I-HW/RW		23:1644
	5	15-007(d)	A	Drilled shaft	TA15-3-CA-I-HW/RW		23:1644
SURFACE DISPOSAL							
	7	15-008(a)	A, B	Surface disposal	TA15-5-CA/OL-I-HW/RW		23:1621
	9	15-008(b)	A, B	Surface disposal	TA15-1-CA-I-HW/RW		23:1623
	8	15-008(c)	A, B	Surface disposal	TA15-7-CA-I-HW/RW		22:1531
	6	15-008(d)	A, B	Building debris	TA15-5-CA/OL-I-HW/RW		24:1594
	5	15-008(e)		Dirt mound			22:1533
	11	15-008(f)					23:1625
	6	15-008(g)		Sand bag pile			23:1626 1627
SEPTIC SYSTEM (ACTIVE)							
	5	15-009(a)	A, B	Seepage pit	TA15-9-S/ST/O-A-HW/RW	EID LA-15	24:1554 1571 1572
	6	15-009(b)	A, B	Seepage pit	TA15-9-S/ST/O-A-HW/RW	EID LA-16	23:1613
	6	15-009(c)		Septic system	TA15-9-S/ST/O-A-HW/RW	EID LA-17	23:1609 1614
	5	15-009(d)		Seepage pit	TA15-9-S/ST/O-A-HW/RW	EID LA-18	24:1555 1567 1573
	7	15-009(e)		Septic system	TA15-8-S/ST/O-A-HW/RW		23:1608 1612
	10	15-009(f)		Seepage pit	TA15-9-S/ST/O-A-HW/RW	EID LA-20	22:1526
	6	15-009(g)		Leach field	TA15-9-S/ST/O-A-HW/RW	EID LA-21	23:1615
	6	15-009(h)		Leach field	TA15-9-S/ST/O-A-HW/RW	EID LA-22	23:1616
	8	15-009(i)		Septic system	TA15-9-S/ST/O-A-HW/RW	EID LA-23	22:1527
	10	15-009(j)		Seepage pit	TA15-9-S/ST/O-A-HW/RW	EID LA-37	22:1528
	10	15-009(k)		Leach field			
SEPTIC SYSTEM (INACTIVE)							
	5	15-010(a)	A	Septic tank	TA15-8-S/ST/O-I-HW/RW		24:1569
	10	15-010(b)	A	Septic tank	TA15-8-S/ST/O-I-HW/RW		24:1570
	8	15-010(c)	A	Storm drain	TA15-8-S/ST/O-I-HW/RW		23:1607 1611

TABLE 1.2-1 (*Cont.*)
INVESTIGATION GROUPS AND DESIGNATIONS

Group	Work Plan Chapter	Current SWMU No.	EPA Priority A, B	Description	Comprehensive Environmental Assessment and Response Program (CEARP) I.D. No.	RFA Unit EID No. EPA No.	ER Release Site Info. Task No.
SUMP							
	10	15-011(a)	A	Sump	TA15-8-S/ST/O-I-HW/RW		24:1579 1580 1582
	10	15-011(b)	A	Drywell	TA15-8-S/ST/O-I-HW/RW	15.011	24:1577 1581
	10	15-011(c)	A	Sump	TA15-8-S/ST/O-I-HW/RW	15.002	24:1556 1578
OPERATION RELEASE							
	5	15-012(a)	A, B	Vacuum pump oil disposal		15.008	24:1589
	10	15-012(b)	A, B	Surface disposal	TA15-5-CA-OL-I-HW/RW		22:1529
UNDERGROUND TANK							
	5	15-013(a)		Removed tank			24:1605
	5	15-013(b)		Removed tank	TA15-10-UST-A-PP	15.019	
OUTFALL							
	10	15-014(a)		Outfall	TA15-9-S/ST/O-A-HW/RW	EPA 06A123	22:1524
	10	15-014(b)		Storm drain			22:1525
	5	15-014(c)		Sink drain			22:1553
	5	15-014(d)		Outfall			23:1610
	5	15-014(e)		Cooling water	TA15-9-S/ST/O-A-HW/RW	EPA 04A139	23:1619
	5	15-014(f)		Cooling water	TA15-9S/ST/O-A-HW/RW	EPA O4A121	23:1620
	5	15-014(g)		Cooling water	TA15-8-S/ST/O-I-HW/RW		23:1557 1586
	10	15-014(h)		Cooling water	TA15-8-S/ST/O-I-HW/RW	EPA 04A013	24:1558 1559 1564 1565
				Outfall		EPA 04A102	1566 1568
	10	15-014(i)	A, B	Drainline outfall		EPA04A093	24:1560 1563
	10	15-014(j)	A, B	Drainline outfall			24:1561 1562 1574
	10	15-014(k)	A, B	Drainline outfall	TA15-8-S/ST/O-I-HW/RW		24:1575 1576
	5	15-014(l)	A, B	Drainline outfall		EPA 03A028	
	5	15-014(m)	A, B	Cooling water		EPA 04A143	

TABLE 1.2-1 (*Cont.*)

INVESTIGATION GROUPS AND DESIGNATIONS

Group	Work Plan Chapter	Current AOC No.	EPA Priority A, B	Description	ER Release Site Info. Task No.
AREAS OF CONCERN					
	8	C-15-001		Soil pile contaminated with radionuclides	22:1530
	5	C-15-002		Soil pile contaminated with metals, radionuclides, and HEs	22:1532
	5	C-15-003		Pile of black granular material	22:1624
	7	C-15-004		A transformer station consisting of 2 transformers, removed	23:1631
	9	C-15-005		Former location of TA-15-1, removed in 1962	24:1583
	9	C-15-006		Former location of TA-15-7, removed in 1962	24:1584
	10	C-15-007		Stained soil on exterior southwest corner of building TA-15-194	24:1585
	5	C-15-008		Puddle of clear liquid north of oil storage tank TA-15-261	24:1587
	5	C-15-009		Inactive underground fuel storage tank, removed	
	10	C-15-010		Inactive underground fuel storage tank, removed	
	8	C-15-011		An inactive 218 gallon underground gasoline storage tank	
	5	C-15-012		An active 15 000 gallon underground dielectric oil storage tank	
	5	C-15-013		An inactive 1200 gallon underground ethylene glycol storage tank	

TABLE 1.2-2

CORRELATION OF PAST AND PRESENT SWMU NUMBERS

Current SWMU no.	Previous SWMU no.
15-004(a)	15-004(a) + (b)
15-004(b)	15-004(c) + (d)
15-004(c)	15-004(e) + (l)
15-004(d)	15-004(f)
15-004(e)	15-004(g)
15-004(f)	15-004(h) + (m)
15-004(g)	15-004(i), (j), (n)
15-004(h)	15-004(k) + (o)
15-014(g)	15-014(f)

All unlisted SWMU numbers remain the same.

Because the OU 1086 RFI is scheduled to be completed in approximately 5 yr (Phase I and Phase II) contingent on the availability of funding, the Laboratory proposes to submit phase reports regarding site characterization activities for OU 1086 PRSs. These phase reports will update the EPA and other interested parties on RFI field work progress and will furnish the work plan for any SWMUs that are not on the HSWA Permit List and not described in this RFI work plan. These update memos may also serve as work plan modifications for revising field sampling plans, as appropriate, to reflect initial characterization results. Therefore, phased reports will be essentially partial RFI Phase I reports and partial RFI Phase II work plans. The schedule for these phased reports/work plan modifications is presented in Figures EXEC-5, EXEC-6, and EXEC-7, and Annex I of this volume.

1.3 Work Plan Organization

The purpose of the OU 1086 Work Plan is threefold:

1. To determine the nature and extent of the contamination within each PRS;
2. To serve as the detailed field sampling plan for personnel who will implement the RFI characterization activities; and
3. To satisfy the regulatory requirements of the HSWA Module.

The HSWA Module sets out the general scope of the work plan, establishes the expected correspondence between the RFI tasks identified in EPA guidance documents (EPA 1989, 0088) and the equivalent ER Program tasks, and specifies the requirements to be fulfilled, as outlined in the IWP and the OU work plans. These expectations are summarized in Table 1.3-1, which has been adapted from the HSWA Module (page 32).

Table 3.2 of the 1991 IWP proposes an outline for OU work plans. The present OU 1086 work plan includes all the elements specified by this outline, but the form has been modified to be more logically consistent with the proposed TA-15 work. A complete project management plan for OU 1086 is contained in Annex I of The Work Plan.

The EPA defines five general tasks within the RFI process (EPA 1989, 0088; EPA 1990, 0306). These RFI tasks and the chapters in the OU 1086 work plan that address each task are as follows:

RFI Task I, Description of Current Conditions. This task consists of a presentation of facility background information and a general discussion of the nature and extent of contamination. Historical background information on TA-15 is presented in Chapter 2, environmental setting in Chapter 3, and known data related to each PRSs in Chapters 5 through 10.

RFI Task II, RFI Work Plan. This task requires plans for quality assurance, data management, health and safety, and community relations. These plans are presented in Annexes II through V.

RFI Task III, Facility Investigation. This task sets out requirements for further environmental characterization of the site. The environmental setting is described in Chapter 3, and known data on the nature and extent of contamination at individual PRSs are presented with the field investigation objectives and sampling plans in Chapters 7 through 10. Pathway and assessment considerations are discussed in Chapter 4.

RFI Task IV, Investigative Analysis. This task contains subsets of data analysis and protection standards and is addressed in the IWP.

RFI Task V, Reports. This task calls for preliminary, work plan, progress, draft, and final reports. As outlined in Chapters 1 and 2, Laboratory work plans are provided on an installation-wide basis (the IWP) and for specific ER Program activities. The site-specific OU 1086 work plan has been prepared in accordance with this requirement. Table EXEC-4 gives a schedule for OU 1086 reports. Periodic reports for the entire ER Program, as well as draft and final RFI Reports, will be submitted as described in the IWP.

The locations of all HSWA Module requirements in ER documents are shown in Table 1.3-1.

TABLE 1.3-1
RFI GUIDANCE FROM THE LABORATORY'S RCRA PART B PERMIT AND CORRESPONDING PORTIONS OF THE TA-1086 RFI WORK PLAN

HSWA Module Requirements		ER Program Equivalent	
RCRA facility investigation specified tasks:	LANL IWP	LANL task/site remedial/Ilinvestigation/ Facility Study (RI/FS)	Corresponding portions of the OU 1086 work plan
Task I: Description of current conditions	I. LANL Installation RI/FS work plan	I. Task/site conditions	I.
A. Facility background	A. Installation background	A. Task/site background	A. Chapters 1–3
B. Nature and extent of contamination	B. Tabular summary of contamination by site	B. Nature and extent of contamination	B. Chapters 5 – 10
Task II: RFI work plan	II LANL Installation RI/FS work plan	II. LANL task/site RI/FS documents	II.
A. Data collection quality assurance (QA) plan	A. General SOPs for sampling, analysis, and QA	A. QA project plan and field sampling plan	A. Annex II and Chapters 5 – 10
B. Data management plan	B. Technical data management program	B. Technical data management plan	B. Annex IV
C. Health and safety plan	C. Health and safety program	C. Health and safety plan	C. Annex III
D. Community relations plan	D. Community relations program	D. Community relations plan	D. Annex V
E. Project Management Plan	E. Project Management Plan		E. Annex I
Task III: Facility investigation	III.	III. Task/site investigation	III.
A. Environmental setting	A. IWP Chapter 2	A. Environmental setting	A. Chapter 3
B. Source characterization	B. IWP Appendix G	B. Source characterization	B. Chapters 5 – 10
C. Contamination characterization	C. IWP Appendix G	C. Contamination characterization	C. Chapters 5 – 10
D. Potential receptor identification	D. IWP Subsection 4.2	D. Potential receptor identification	D. Chapter 4
Task IV: Investigative analysis	IV	IV. LANL task/site investigative analysis	IV.
A. Data analysis	A. IWP Subsection 4.2	A. Data analysis	A. IWP
B. Protection standards	B. IWP Subsection 4.2	B. Protection standards	B. IWP
Task V: Reports	V. Reports	V. LANL task/site reports	V.
A. Preliminary and work plan	A. LANL Installation RI/FS Work Plan	A. QA project plan, Field sampling plan, technical data management plan, health and safety plan, community relations plan	A. Annexes I - V
B. Progress	B. Annual update of LANL Installation RI/FS Work Plan	B. LANL task/site RI/FS documents and LANL monthly management status report	B. Chapter 1; Annex I
C. Draft and final	C. Draft and final	C. Draft and final	C. Chapter 1; Annex I

1.4 Description of the TA-15 Operable Unit and Solid Waste Management Units

TA-15, also known as R-Site, occupies portions of Three-Mile Mesa and Pajarito Mesa near the southwestern boundary of the Laboratory. Figure EXEC-1 shows the regional location of the Laboratory and Figure EXEC-2 shows the location of TA-15 with respect to other Laboratory TAs as well as public and private properties surrounding the Laboratory. Figure EXEC-3 identifies the location of SWMUs and other salient site features at TA-15. TA-15 occupies approximately 1200 acres. Its boundaries are defined by TA-66 and TA-67 to the north; TA-14, TA-16, TA-37, and TA-49 to the west and south; and TA-36 to the east.

Appendix A contains a topographic map of TA-15. Appendix D contains site maps and drawings, survey coordinates of a Material Disposal Area, and other engineering details relevant to the OU 1086 RFI. Details of the TA-15 environment, its past use, and release sites are given in Chapters 3-10.

Much of TA-15 has been used from the mid-1940s to the present time for explosives experiments. In that capacity, test explosions ranging from a few kilograms of high explosives (HEs) to as much as 650 kg have been detonated in arrangements that duplicate many of the components of a nuclear weapon, with the exception of the fissionable material. These components have contained multikilogram quantities of natural uranium metal, depleted uranium metal, beryllium metal, and lesser quantities of other metals. In most cases, the tests are carried out aboveground, which results in the test materials being scattered over areas that are sometimes hundreds of square meters. Based on laboratory records, some 75 metric tons of uranium, both natural and depleted, have been expended at the firing sites on TA-15 since the mid-1940s.

Dynamic radiography is one of the major tools used at these firing sites to obtain data on the hydrodynamic performance of the weapon components. Short-duration bursts of X-rays, after passing through the explosion, are recorded on film. These "pictures" of the explosion can be examined to determine if the components were acting as predicted. The two sets of stationary X-ray-emitting equipment are called PHERMEX (pulsed, high-energy, radiographic machine emitting X-rays) and Ector (the name given to the diode-type pulse power machine at R-306).

CHAPTER 1 REFERENCES

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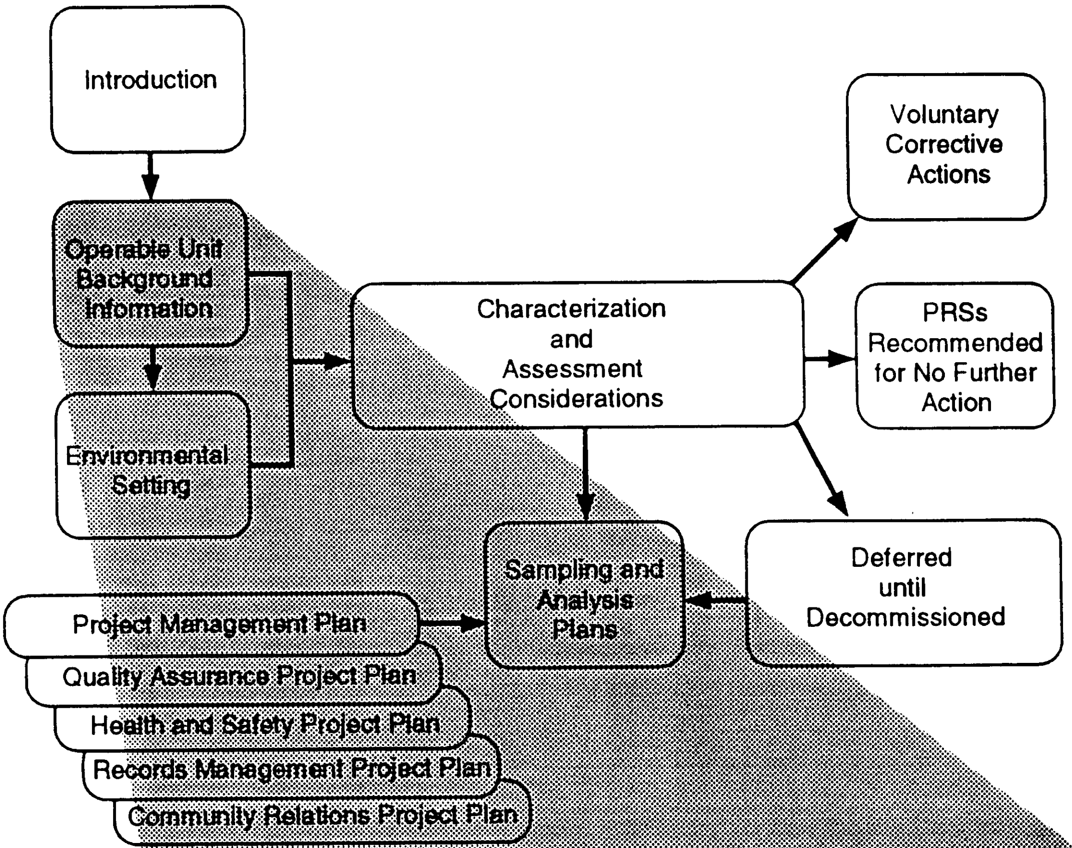
CHAPTER 2



Background Information for the TA-15 Operable Unit

- Location
- History
- Past Waste Management Practice
- Current Conditions
- Sources of Information

2.0 OPERABLE UNIT BACKGROUND INFORMATION

This chapter presents a brief overview of past and current uses of Technical Area-15 (TA-15). Greater detail is contained in Chapters 4, 6, and 7.

2.1 Location

TA-15 is bounded by TAs 66 and 67 to the north, TAs 14, 16, 37, and 49 to the west and south and TA-36 to the east. The relatively flat surface of Three-Mile Mesa on Pajarito Mesa encompasses most of TA-15, but steep-walled Water Canyon traverses the southern site boundary and Potrillo Canyon intersects the main portion of Three-Mile Mesa, dividing the Mesa into two firing site areas on PHERMEX Mesa and Mesita del Potrillo. Chapter 3 provides additional information on the TA-15 environmental setting. Figure 2.1-1 shows an aerial view of the Laboratory including TA-15.

Figures EXEC-1 and EXEC-2 show the regional location of the Laboratory and the location relative to other Laboratory sites and perimeter properties. Figure EXEC-3 shows a site diagram of TA-15 and its associated PRSs. A topographic map of TA-15 is contained in Appendix A. Detailed engineering drawings, site maps, survey coordinates for shafts and Material Disposal Areas (MDAs) N and Z [SWMU nos. 15-007(a) and 15-007(b), respectively] and other information relevant to the TA-15 RFI are contained in Appendix D.

2.2 History

This section describes the prehistoric use, early use, and laboratory acquisition of Three-Mile Mesa and the historical development, environmental monitoring, and hazard ranking of TA-15.

2.2.1 Prehistoric Use

Three-Mile Mesa has seen extensive prehistoric use (Steen 1977, 0660; Steen, 1982, 0659). Ruins and artifacts are widespread across the mesa top, including some near PRSs. An archaeological survey, carried out in conjunction with the TA-15 RFI, documents this use and assesses the potential RFI impact on cultural resources (Appendix E). It is expected that a categorical exclusion for TA-15 (RCRA) Facility Investigation (RFI) activities will be issued by the Department of Energy (DOE).

2.2.2 Early Uses and Laboratory Acquisition

Much of the Pajarito Plateau, including present-day TA-15, was part of the Ramon Vigil land grant. In the late 1800s and early 1900s, the Pajarito Plateau, including portions of Three-Mile Mesa, was used for ranching, farming, and/or timber production.

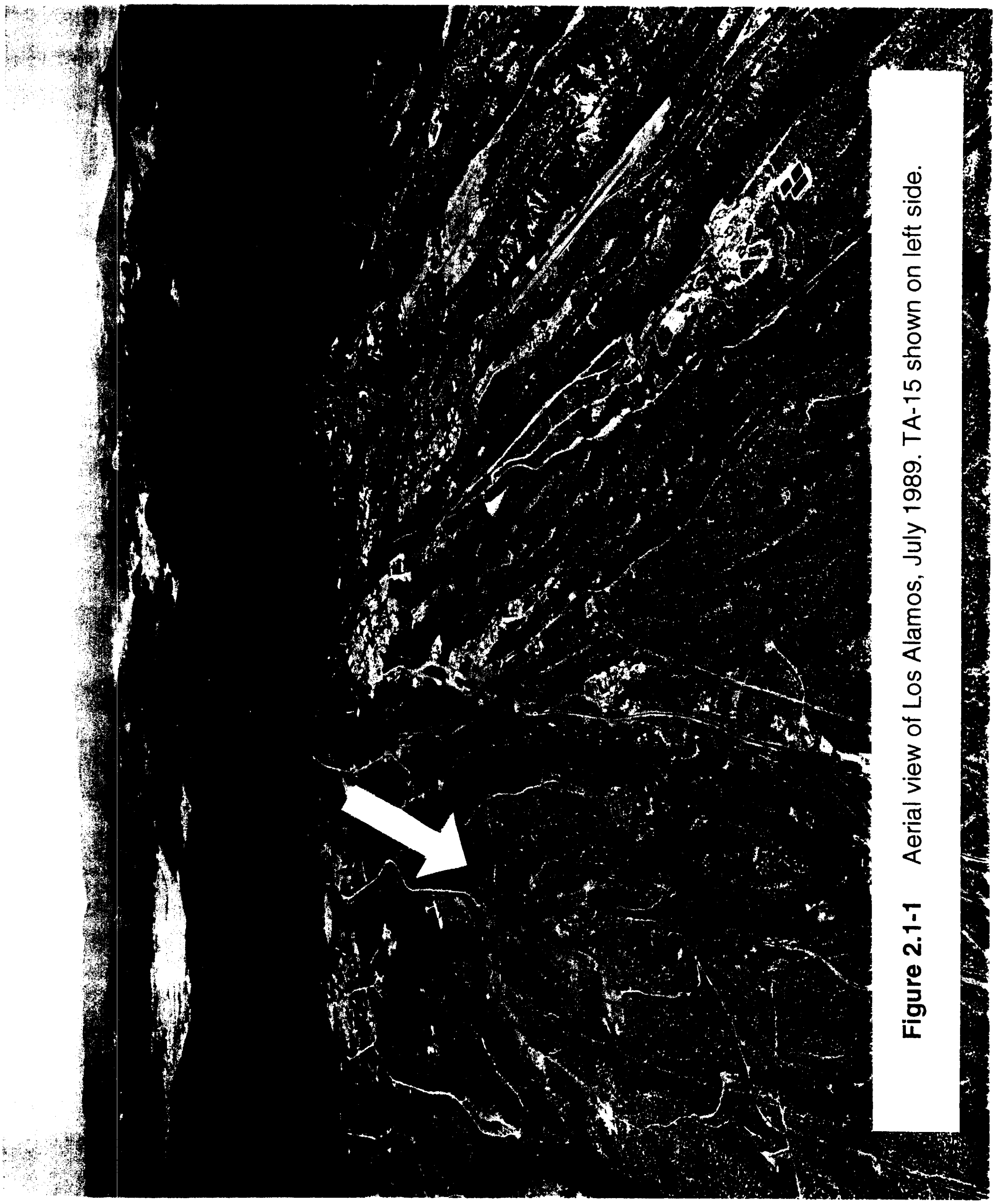


Figure 2.1-1 Aerial view of Los Alamos, July 1989. TA-15 shown on left side.

Three-Mile Mesa was added to the Santa Fe Forest Reserve together with the rest of the Jemez Section in 1915. The area encompassing present-day TA-15 was acquired from the US Forest Service (Santa Fe National Forest) in two parcels, as is documented by memoranda of understanding (MOUs) with the Manhattan Engineering District dated May 15, 1943 (9360 acres) (ENG-R 1656 1968, 03-0029).

From the time of its acquisition by the Laboratory in the 1940s to the present day, the portion of Three-Mile Mesa that contains TA-15 has encompassed a number of firing sites.

2.2.3 Historical Development of TA-15

In 1944 a small control building and two firing sites–one for quantities of high explosives (HEs) up to 50 lb and the second for larger amounts–were established on TA-15. The exact location of these two firing sites and the types of tests that were carried out have not been determined definitively in a search of the archives, but it is probable that these became Firing Points A and B. Firing Point A was probably in use by the end of 1944, and nearby Firing Point B shortly thereafter. In 1946 the decision was made to make TA-15 into a permanent location for explosive experiments related to the design of nuclear weapons, which could and did involve experiments with up to 2 tons of HEs. By 1947 Firing Points C, D, and E-F were in use. In 1948 Firing Points G and H were added. Firing Points A–H are not used today, and most of the structures associated with these firing sites have been decommissioned and dismantled. The hazardous materials used in these explosion tests, such as uranium, beryllium, and lead, have largely been left in place at the firing sites where the materials were deposited by the explosion or pushed aside to clean the area. Other materials that may have been deposited include steel, aluminum, mercury, boron, cadmium, gold, and tritium, although in very small amounts. Many types of HEs have been used at these sites, and they certainly have left some inorganic residues, but no unexploded HEs have been found in analyses at firing site soils. Firing Point E-F was used the most heavily and contains the largest quantities of hazardous materials. Up to 65 000 kg of uranium and approximately 350 kg of beryllium have been expended in tests at Firing Point E-F.

Areas R-40, R-183, and The Hollow are areas containing office buildings in support of TA-15 operations. (See Figure EXEC-3) The buildings in The Hollow have been assembled since 1949 and are intimately connected. The buildings at R-40 have been in place since the early 1950s, and those at R-183 since the early 1960s. Related to those buildings and the surrounding areas are a number of PRSs involving septic tanks, sumps, drainage ditches, outfalls, container storage areas, and other operational releases.

In the 1950s, Firing Sites R-44 and R-45 were completed. Since then, these sites have been used for various explosive tests, with R-45 for smaller tests and R-44 for larger tests.

The PHERMEX facility was built in the early 1960s to perform dynamic radiography of the components of nuclear weapons during the explosion. A second major dynamic radiographic machine named Ector, was installed in the early 1980s for studies similar to those at PHERMEX. A new facility known as DARHT (Dual-Axis Radiographic Hydrodynamics Test) is being planned.

Further details and references on the historical development of operations at TA-15 are given in the description of individual PRSs, Chapters 5–10.

2.3 Environmental Monitoring at TA-15

A number of different environmental monitoring procedures currently are followed at TA-15. First, all explosive tests on TA-15 are carried out according to approved standard operating procedures (SOPs). In any experiment involving potentially hazardous materials, such as depleted uranium, and beryllium, monitoring procedures are called out in the SOP for times during and immediately after the experiments to assure that workers on site may approach the firing pad safely. Second, prior to any construction on TA-15, the area involved in the construction is surveyed with a portable survey instrument capable of detecting gamma rays. As appropriate, solid samples also are taken for analysis of hazardous materials. In addition any construction also must go through an extensive Laboratory environmental safety and health (ES&H) process. Construction can proceed only if these surveys and sample analysis show that it is safe to do so. Thirdly, periodic surveys are carried out on active firing sites such as R-44, R-45, PHERMEX, and Ector to assure that an unexpected build-up of uranium and/or beryllium is not taking place. The last survey was conducted in 1991 (Schlapper 1991, 10-0009).

In addition, air samplers and other means for detecting airborne contamination have been deployed during some of the explosions. The information obtained leads to the conclusion that only small amounts of the materials have been aerosolized and carried along with the wind. The Laboratory has used results from these tests to estimate that the maximum amount of uranium and beryllium aerosolized in any test is 10% and 2%, respectively (Dahl and Johnson 1977, 0877).

In addition, site monitoring has been done at TA-36, the technical area immediately east of TA-15, and results have been reported in the Laboratory's annual environmental sampling reports, which extend back to 1970 (e.g., Environmental Protection Group 1990, 0497).

Groundwater from two supply wells located in TA-36 (due east of TA-15) has been tested for radioactive and primary and secondary chemical constituents. Contamination has not been detected in the water supply wells in 1990 (Figure 3.4-3). There are no wells at TA-15 for direct monitoring.

2.4 Hazard Ranking of TA-15

In 1987, the EPA and DOE used the EPA Hazard Ranking System (HRS) and the DOE-modified HRS to assess the potential for migration of chemical and radioactive contaminants (DOE 1987, 0264). Despite the existence of uranium and beryllium spread over the surface of some of the firing sites at TA-15, the maximum overall migration mode score of 9.9 and direct contact score of 4.2 reflect low potential for contaminant migration and exposure and are far below the score of 28.5 required by the EPA for the site to be included in the National Priorities List (CERCLA "Superfund" list).

2.5 Past Waste Management Practices

Firing site experiments, sanitary wastes, and cleanup wastes at TA-15, together with current conditions in that area, are discussed in the following subsections.

2.5.1 Firing Site Experiments

Because of the remote location of TA-15 in relation to the main population living in Los Alamos County and to the main body of employees working at the Laboratory, the explosions were usually not set off inside containment vessels, but rather in the open air. The by-products of the explosion were allowed to expand freely and to settle back on the ground in the vicinity of the experiment. Each explosion, depending on the amount of HEs, had a hazard radius associated with it in which personnel must be under protective cover during the actual explosion, and this radius was calculated before each experiment. The area on which the main portion of the hazardous material was scattered was much smaller than this administrative hazard radius. After each experiment, the area nearby the center of the explosion was cleared of physical debris to accommodate the next experiment. Periodic surveys were conducted to determine the extent of the most contaminated portion of the firing site. In some of the firing sites, sandbags, (filled with sand or a concrete mixture), and steel blast mats were used to protect nearby buildings. When the sandbags and mats deteriorated, they were removed and replaced with fresh sandbags and mats. In the past, this debris was placed in Material Disposal Area Z (MDA-Z), SWMU 15-007(b) at Firing Site G (DOE 1987, 0264), but this practice was stopped about 1981 when the Laboratory began to truck such debris as low-level radioactive waste to the TA-54 landfill.

Although MDA-Z is no longer used, it has not been covered or reclaimed.

Currently the same procedures are used for firing site experiments. However, the size of the shots is dramatically lower. The maximum used in the last 10 yr for a single shot is about 45 kg high explosive (HE), well under the limit imposed in 1982 of 67 kg (150 lb) for the new firing bunkers at R-306 and R-310. The limit at PHERMEX remains 450 kg (1000 lb).

2.5.2 Sanitary Wastes

The overflow from each sanitary waste line, until the mid 1970s, emptied through an outfall into one of the nearby canyons. In the mid 1970s a sump was constructed in the exit line from five of seven septic tanks, and the outfalls from six of seven septic tanks were plugged. The remaining unplugged outfall [SWMU 15-009(e)] receives only sanitary waste. The main use of these septic systems was for the disposal of sanitary sewage. However, there is some evidence that an outfall from one of the buildings (TA-15-40) probably was used to dispose of photographic solutions, and another septic system (shop TA-15-8) probably contains some HEs from machining of HEs there.

Table 2.5-1 lists the National Pollutant Discharge Elimination System (NPDES) outfalls.

TABLE 2.5-1
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM OUTFALLS.

Building Number Category	SWMU Number	Type of Discharge	NPDES Serial #	Status
194 04A	15-014(i)	Noncontact cooling water	093	Eliminated 1992
184 04A	15-014(e)	Noncontact cooling water	139	Submitted to EPA 11/87
306 04A	15-014(m)	Noncontact cooling water	143	Submitted to EPA 11/87
183 06A	15-014(a)	Photo wastes	123	
202 (CT) 03A	-	Treated cooling water	028	

2.5.3 Cleanup Wastes

Material Disposal Area-N (MDA-N), SWMU 15-007(a) to the south of R-40 was used prior to 1965 for disposal of debris from the dismantlement of structures within TA-15. Whether this material is contaminated with hazardous material is not known. Personnel acquainted with the area believe that the amount of any radioactive material is low because structures were usually surveyed for radioactive contamination before being torn down. In 1967, a major cleanup effort was carried out to remove unused structures. In this case the surveys are well documented (Courtright 1965, 10-0034; Buckland 1965, 10-0032 and Courtright 1967, 10-0035) and the structures were shown to be free from radioactive and HE contamination. This debris was removed from TA-15.

From approximately 1965 to 1981, construction debris, used sandbags and other shielding from tests at PHERMEX, and other miscellaneous debris were deposited in MDA-Z, SWMU 15-007(b), located on the south mesa of TA-15.

2.6 Current Conditions at TA-15

TA-15 is an active technical area of the Laboratory used by one group (M-4) of the Explosives Technology and Applications (M) Division for on-going explosion research. Planning for future Laboratory use of this area also stipulates that the area will continue to be used for explosion research (Facilities Engineering Division Planning Group et al. 1990, 0655).

Access to TA-15 is controlled by this M Division operating group. Because most work on this site is classified, only Q-cleared personnel can routinely enter this site as far as its group office. In addition, permission and control keys must be obtained from Group M-4, hydrodynamics, before an individual may proceed to the firing sites located beyond the group or engineering offices.

Access to and from Water Canyon and Potrillo Canyon also is controlled by the M Division Office, which maintains control of keys to the canyon access road gates.

In the ongoing Laboratory Environmental Surveillance Program, water samples are collected at least annually from two deep water supply wells located at TA-36 due east of TA-15 and also from three wells at TA-49, due south of TA-15. Sediment stations down-gradient from TA-15 in Water Canyon and Potrillo Canyon are also sampled annually. Air and air radiation monitoring stations are present at TA-49 near the State Road 4 gate and throughout the Laboratory site (see Figure 2.6-1). The environmental measurements obtained from these air monitoring stations, over three decades, have given no evidence that contaminants attributable to past or present TA-15 operations have been transported beyond the technical area boundaries.

The environmental surveillance report for studies in 1989 (Environmental Protection Group 1990, 0497) indicates that the DOE radiation protection standard (RPS), under which the Laboratory operates, limits incremental radiation doses (effective dose equivalent) to the general public from all Laboratory operations to 100 mrem/yr from all pathways. In addition, the air pathway exposure route is limited to 10 mrem/yr in accordance with EPA requirements. For comparison, the average background radiation exposure to individuals living in Los Alamos is approximately 336 mrem/yr from all sources (Environmental Protection Group 1990, 0740). Nearby TA-49 radiation monitoring stations have never measured radioactivity levels more than 1% of applicable DOE or EPA guidelines.

The ESG report for environmental surveillance during 1989 estimates that the maximum incremental risk of cancer from radiation to Los Alamos residents as a result of all 1989 Laboratory operations is about 1 by 10^{-8} (Environmental Protection Group 1990, 0497). Of that risk, the contribution from TA-15 is exceedingly small.

2.7 Local Populations

Section 2.5 of the IWP describes the population distribution within a 50-mile radius of the Laboratory. The IWP presents a table documenting population density at nine distance intervals for 16 compass directions, based on 1989 projections from 1980 census data. Newer data from the 1990 census give the total number of residents within the 50-mile radius of the Laboratory as 213 000. About 50 people normally reside at Bandelier National Monument (BNM). BNM operates a remote radio transmitter near the main gate to TA-49, but no other

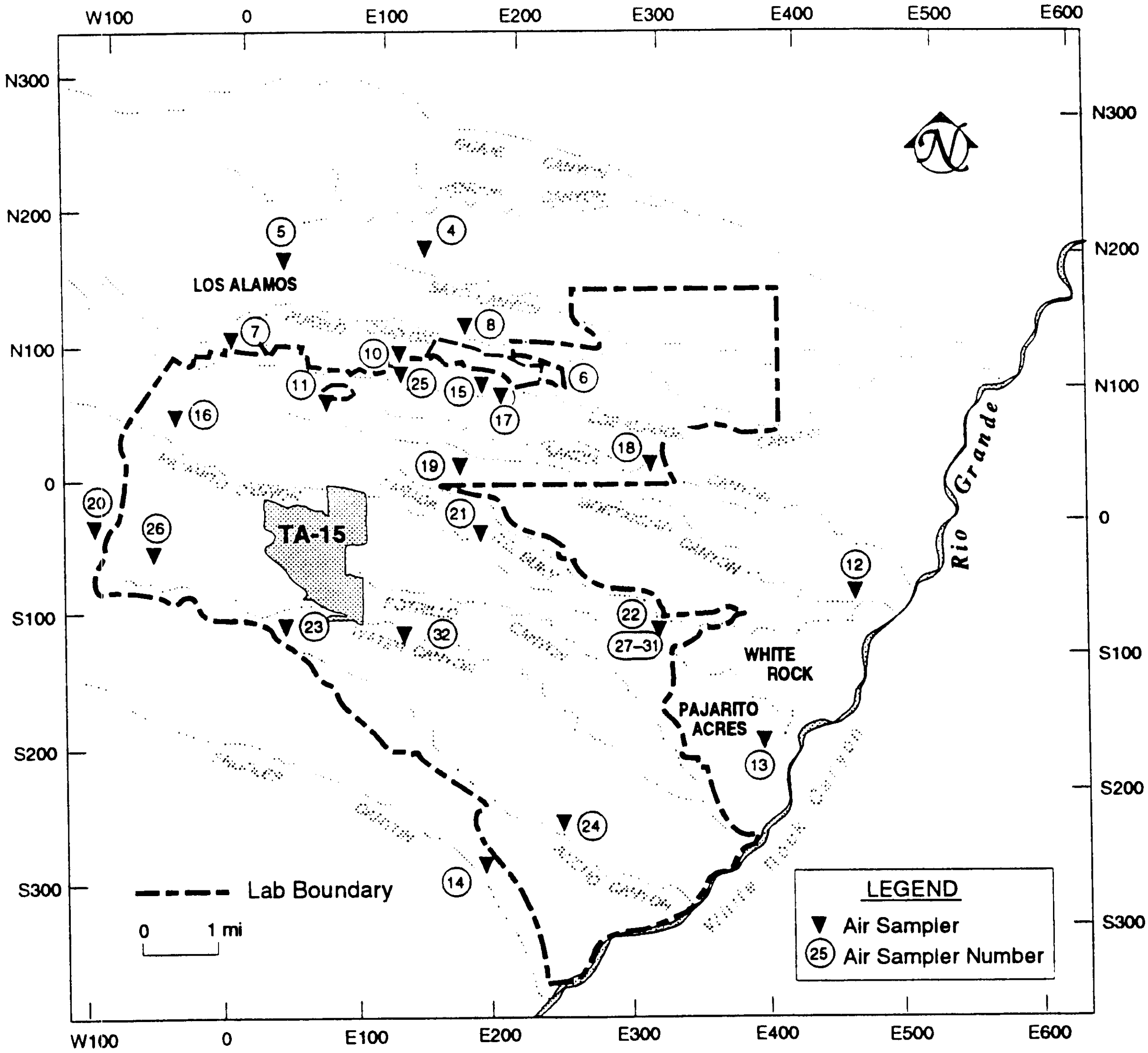


Figure 2.6-1 Locations on or near the Laboratory site for sampling airborne radionuclides (Environmental Protection Group 1990, 0497).

use (including hiking trails) is currently made (or is planned) of BNM property south of TA-49 to Frijoles Canyon. Most people at Bandelier are visitors who spend only a few hours there. About 350 000 people visited BNM in 1990.

The two next closest residential communities to TA-15 are located 6 km to the east in White Rock, and the town-site of Los Alamos, which lies approximately 7 km to the north. The 1990 census gives the population of White Rock as 6800 and of Los Alamos as 11 400.

State Road 4 is a lightly used, publicly accessible road along the southern boundary of TA-49, south of TA-15. According to the Laboratory's Engineering Division, yearly average traffic on this road is about 700 vehicles per day. The point of closest public approach to a TA-15 PRS (PHERMEX) is about 2 km.

2.8 Sources of Information

Available environmental data for TA-15 were acquired by using current standard practices and methods. No attempt has been made to validate these data in the EPA sense of the term. These data are used in this document as a guide to RFI characterization and sampling.

Many key personnel involved in the activities at TA-15 since its beginning in approximately 1944 were interviewed directly. Among these individuals are scientists who carried out experiments at each of the named inactive firing sites located on TA-15 as well as at the current active firing sites.

Other sources of information also have been used.

- The Laboratory's environmental monitoring network. This network includes on-site stations as well as perimeter and regional stations that are not influenced by Laboratory operations. These studies are reported in annual reports of the environmental surveillance group.
- Special studies conducted at the Laboratory and in the region. Researchers collected environmental data for these studies in areas unaffected by Laboratory operations. These studies are described in periodic Laboratory reports.
- General environmental data. These data address the behavior of chemicals, elements, and radionuclides in natural systems. These reports are available in peer-reviewed scientific literature.
- Unpublished internal Laboratory memoranda, reports, and drawings.
- Published special studies carried out over a period of years on Firing Site E-F.

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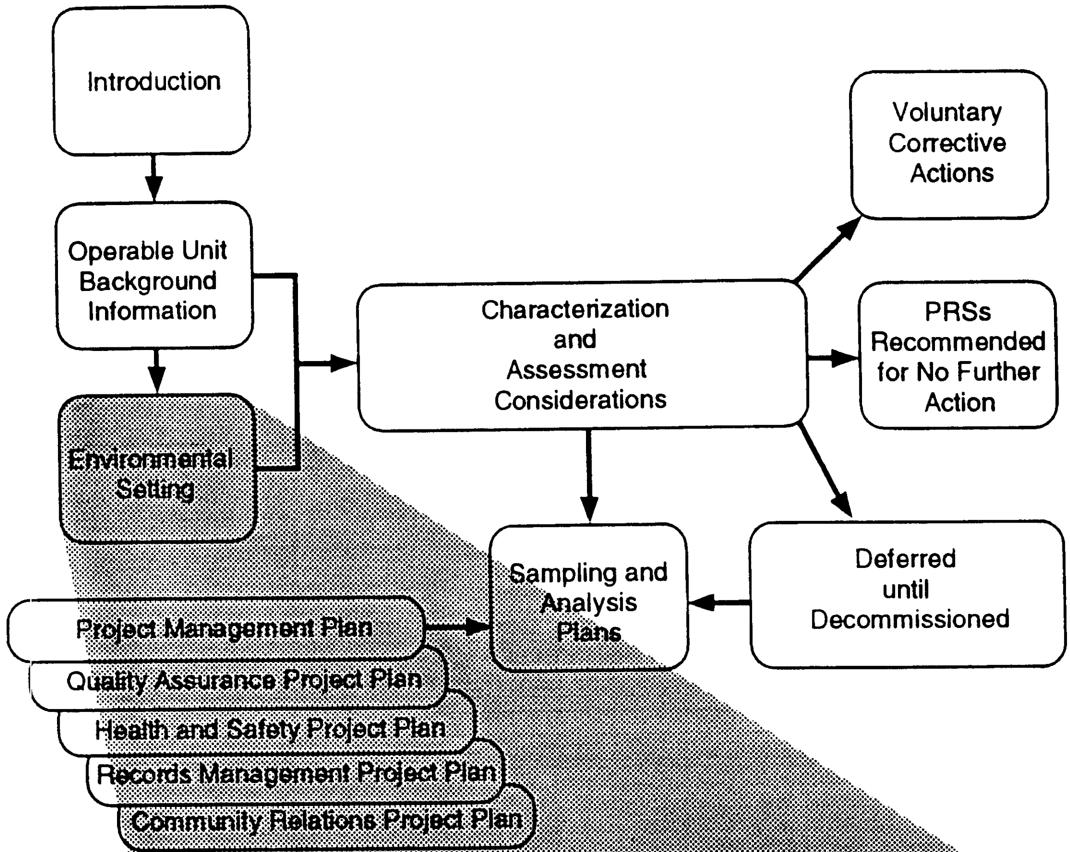
CHAPTER 3



Environmental Setting

- Location and Topography
- Climate
- Biological and Cultural Resources
- Geology and Soils
- Hydrology
- Hydrogeologic Model

3.0 ENVIRONMENTAL SETTING OF THE TA-15 OPERABLE UNIT 1086

Chapter 3 provides a detailed description of the environmental setting at Technical Area (TA)-15, leading to a conceptual model on which the Potential Release Site (PRS)-specific characterization plans (Chapter 7 through 10), recommendations for deferred until decommisioning (Chapter 6), and the recommendations for no further action (NFA) (Chapter 5) are based. Reference is made, as appropriate, to information given in Chapter 2 of the Installation Work Plan (IWP) (LANL 1991, 0553), which discusses the regional environmental setting.

Chapter 3 presents and interprets existing information relevant to TA-15 by section, as follows:

- 3.1 Location and Topography
- 3.2 Climate
- 3.3 Biological and Cultural Resources
- 3.4 Geology and Soils
- 3.5 Hydrology
- 3.6 Hydrogeologic Model

Sections 3.1 through 3.5 provide a general foundation on which the conceptual model discussed in Section 3.6 is based. This model identifies the potential for contaminant migration at TA-15 using the environmental pathways and receptors that are addressed further in Chapter 4. Chapter 3 also identifies additional information needs related to (1) expanding our conceptual understanding of the environmental processes at TA-15 and (2) assessing the magnitude and importance of potential exposure routes.

The development of general data needs and the site conceptual model in Chapter 3 are used to evaluate the nature, quantity, and quality of data required to support the purposes of the TA-15 RCRA Facility Investigation (RFI) as summarized in subsequent chapters.

The general data requirements and conceptual model identified in Chapter 3 also are used to develop the SWMU-specific field investigation plans presented in Chapters 7 through 10. As field results become available, an iterative process will begin in which the current conceptual model will be updated, the sufficiency of the data for supporting the RFI objectives will be assessed, new data needs will be identified, and new investigations will be designed and carried out to fulfill those needs.

3.1 Location and Topography

Operable Unit (OU) 1086 occupies roughly a rectangular area, about 2.1 km wide by 2.4 km long (see topographic map in Appendix A). The northern boundary is formed by the stream channels in Pajarito and Three-Mile canyons along TAs-46, 66, and TA-67. The area is bounded on the west by TA-14 and the stream channel of Cañon de Valle along TA-16 and TA-37. TA-49 on the southern margin of Water Canyon forms the southern boundary, and TA-36 forms the eastern boundary. The topography is rugged, characterized by relatively narrow mesa tops separated by elongated canyons; the predominant axis of both mesas and canyons is west-northwest to east-southeast.

Five canyons dissect the operable unit; from north to south they are Pajarito Canyon, Three-Mile Canyon, Potrillo Canyon, Cañon de Valle, and Water Canyon. Water and Pajarito canyons head on the flanks of the Sierra de los Valles. Related to this position, they have relatively large watershed areas compared with other watersheds on the Pajarito Plateau and are the deepest canyons in the operable unit. Cañon de Valle also heads in the Sierra de los Valles but has a smaller watershed area and joins Water Canyon within the boundary of the operable unit. Potrillo and Three-Mile canyons are small canyons heading on the Pajarito Plateau. Potrillo Canyon headwaters are located completely within the operable unit, and Three-Mile Canyon has its headwaters relatively close, but upstream of the operable unit boundaries. Both of these canyons have relatively small watershed areas and are shallower than the other canyons. Three-Mile Canyon joins Pajarito Canyon a short distance downstream from the OU boundary. Potrillo Canyon flows into Water Canyon about 8 km downstream from OU 1086. None of these canyons contains perennial flow within this OU.

There is a considerable elevation difference between mesa tops and canyon bottoms, averaging a minimum 30 m vertical drop with a maximum of about 110 m. The maximum elevation of OU 1086 is 2234 m on the mesa west of building TA-15-40, and minimum elevation is 2048 m in Water Canyon. Mesa tops are generally flat and gently slope to the east-southeast. Canyon walls are steep to nearly vertical, ending in large piles of talus at the canyon wall/canyon bottom junction. Canyon bottoms are generally narrow, with steep stream channel gradients.

The entire operable unit, both mesa tops and canyon bottoms, is situated within the Bandelier Tuff, a thick sequence of volcanic ash flows and ash falls on the Pajarito Plateau. In the absence of additional structures, such as faults and fractures, the horizontal uniformity in rock type implies relative uniformity in surface hydrologic and geologic properties throughout the immediate area.

3.2 Climate

Climate is important in terms of contaminant migration because of wind-driven airborne transport and because of the role of surface water in the magnitude and frequency of erosion, as well as its horizontal and vertical transport properties. The local climate at OU 1086 varies only slightly from the Los Alamos area climate as reported in Chapter 2 of the Installation Work Plans (IWP). A major climatologic data collection station for Los Alamos, which provides the information for climatologic summary, was located until recently at TA-59. (There are currently four meteorological stations around the Laboratory.) This site was located about 2.5 km northwest and 30.5 m higher in elevation than building TA-15-40 at TA-15. Precipitation on the Pajarito Plateau is strongly correlated with topography and proximity to the Sierra de los Valles. There is a pronounced annual rainfall gradient from west to east, with the largest values on the west end, closest to the Sierra de los Valles, the topographic high of the area. Taking into account this factor, we estimate the average annual rainfall at OU 1086 to be about 16 in. annually, or about 2 in. less than the 18 in. reported at TA-59 (Bowen 1990, 0033). The reason for this difference is that OU 1086 is farther east and topographically lower than TA-59. Lower precipitation is manifested in amounts of both rainfall and snowfall.

The Laboratory currently maintains two climatologic data collection stations near OU 1086. One station is the TA-6 meteorology tower, located about 2.04 km northwest of OU 1086. This tower replaced a station at TA-59 as a primary climatologic reporting station for Los Alamos in January 1990. A second climatologic data collection station is located at TA-49 about 3.72 km southeast of OU 1086 and near the Laboratory boundary with Bandelier National Monument (BNM). This station has been in operation since 1987. Both stations report precipitation, wind direction and speed, relative humidity, temperature, and solar radiation. A third station that measures precipitation and temperature during nonfreezing days is located about 4.6 km to the east in TA-36.

The predominant prevailing wind direction is from southwest to the northeast (Figure 3.2-1). Surface winds will vary with the time of day, location on the Plateau, and height above the ground because of the area's complex terrain. When the large-scale wind velocities are relatively low and there is sunshine, a superimposed convective, upslope wind develops over the Plateau (flow from southeast to northwest). During clear, relatively calm nights, the flow direction reverses, and a shallow drainage wind (flow from west to east) can develop down the canyons. These upslope/drainage winds prevail at locations some distance from the Rio Grande and are expected to occur at OU 1086.

It has been observed that the mean maximum temperatures are higher in White Rock than in Los Alamos for all months, and the mean minimum temperatures are generally lower in White Rock. Temperature differences for the mean maximum and mean minimum are usually less than 5°F. Temperatures at OU 1086 are expected to range between the Los Alamos and White Rock values.

3.3 Biological and Cultural Resources

The environmental setting of OU 1086 is primarily associated with mesa tops, although there are several canyons that might receive contaminants as a result of chemical transport. The mesa-top environment within the OU consists of ponderosa pine, as the dominant overstory in the western portion, with a gradation to pinon, pine, and juniper in the eastern portions of the site. There are cleared, grassy areas scattered throughout the site.

TA-15 serves as an overwintering area for deer and elk. Other species that are known to occur on the site include a variety of small mammals (mice, coyotes, and others).

Although there is no perennial source of water on the mesa top, the proximity to canyons affords access to water during most of the year. Thus, area wildlife can inhabitat the three different types of habitat without having to move great distances to a water source.

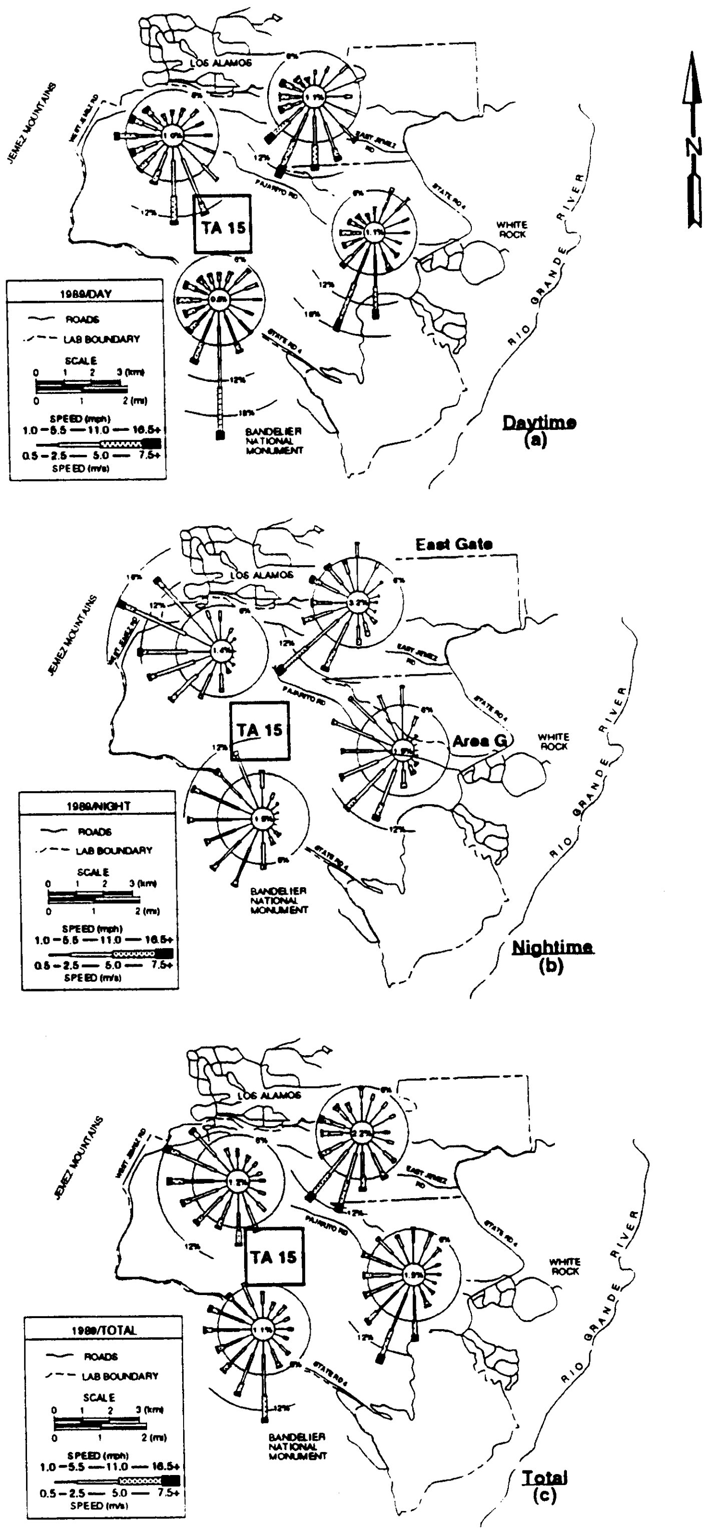


Figure 3.2-1 Wind roses at Laboratory stations during 1989 (from Environmental Protection Group 1990, 0497).

The dominant tree species within OU 1086 are one-seed juniper, pinon, and ponderosa pine. Douglas fir is common in the area and an occasional white fir is found. Common shrub species are Gambel oak, wavyleaf oak, mountain mahogany, cliffbush, and Colorado barberry. The dominant grasses of the area include mountain muhly, little bluestem, and blue grama. Some of the most common forbs found within OU 1086 are golden aster, bittersweet, and wormwood. The following habitat types are found in the operable unit.

Mesa top:
- Ponderosa pine-Gambel oak/pinon phase
- Pinon-Gambel oak
- Pinon-wavyleaf oak

North-facing slopes and canyon bottoms:
- Ponderosa pine-Gambel oak
- Douglas fir-Gambel oak

Within the operable 91 species of plants, 51 species of nesting birds, 24 species of wintering birds, 34 species of mammals, and 10 species of reptiles and amphibians have been identified.

Biological and cultural resources were extensively surveyed in the summer of 1992. Several threatened and endangered species were identified for which TA-15 has a suitable ecology. Further, over 80 sites of cultural interest were located. The details of these investigations are presented in Appendix E.

3.4 Geology and Soils

The stratigraphy, structure, seismicity, and soils of OU 1086 are described in this section.

3.4.1. Stratigraphy

The mesa surfaces in TA-15 are underlain by the upper member of the Bandelier Tuff. The Bandelier comprises two members: upper, or Tshirege, and lower, or Otowi (Figures 3.4-1 and 3.4-2). The younger Tshirege unit is about 1.1 million years old and is separated in time from the Otowi by about 400 000 years. Most of the soils described in Subsection 3.4.3 are derived from the Tshirege. The Tshirege forms the canyon walls throughout TA-15 and is the only rock in the stratigraphic column exposed at this site.

The Tshirege (Smith and Bailey 1966, 0377) consists of multiple flow units of crystal-rich ash-flow tuff and displays significant variations in welding and vapor phase alteration. The Tshirege is underlain by the Tsankawi Pumice Bed (less than 1 m thick) that, in turn, marks the boundary between the Tshirege and the Otowi. The Otowi Member is a nonwelded vitric ash-flow tuff also composed of many units. These two members are separated by an erosion surface that may contain extensive permeable channel gravels and sands (Gardner et al. in press, 0848). Total thickness of Bandelier Tuff in the TA-15 area is about 300 m.

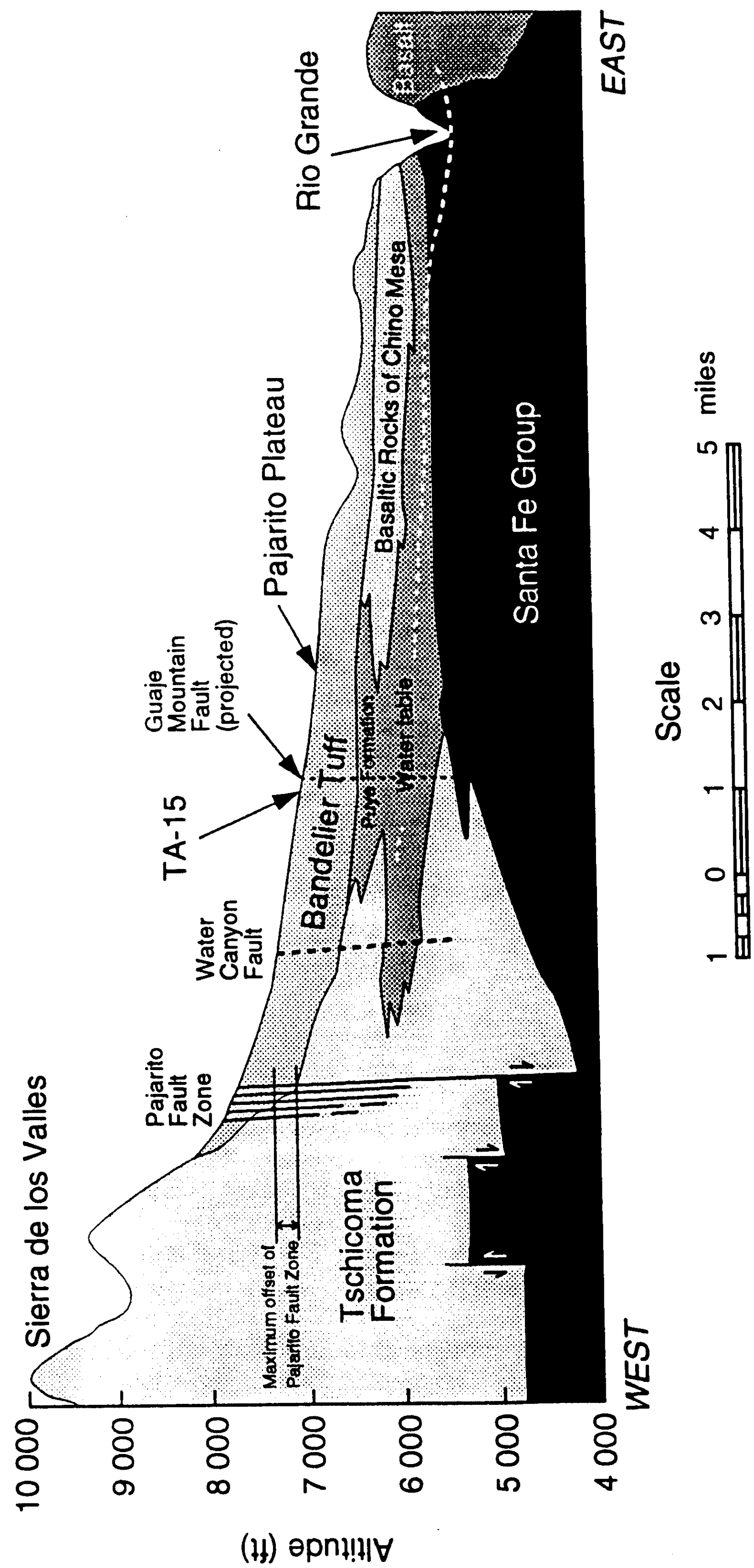


Figure 3.4-1 Geologic section showing the location of TA-15 with respect to stratigraphy and structure from the Sierra de los Valles across the Pajarito Plateau to the Rio Grande.

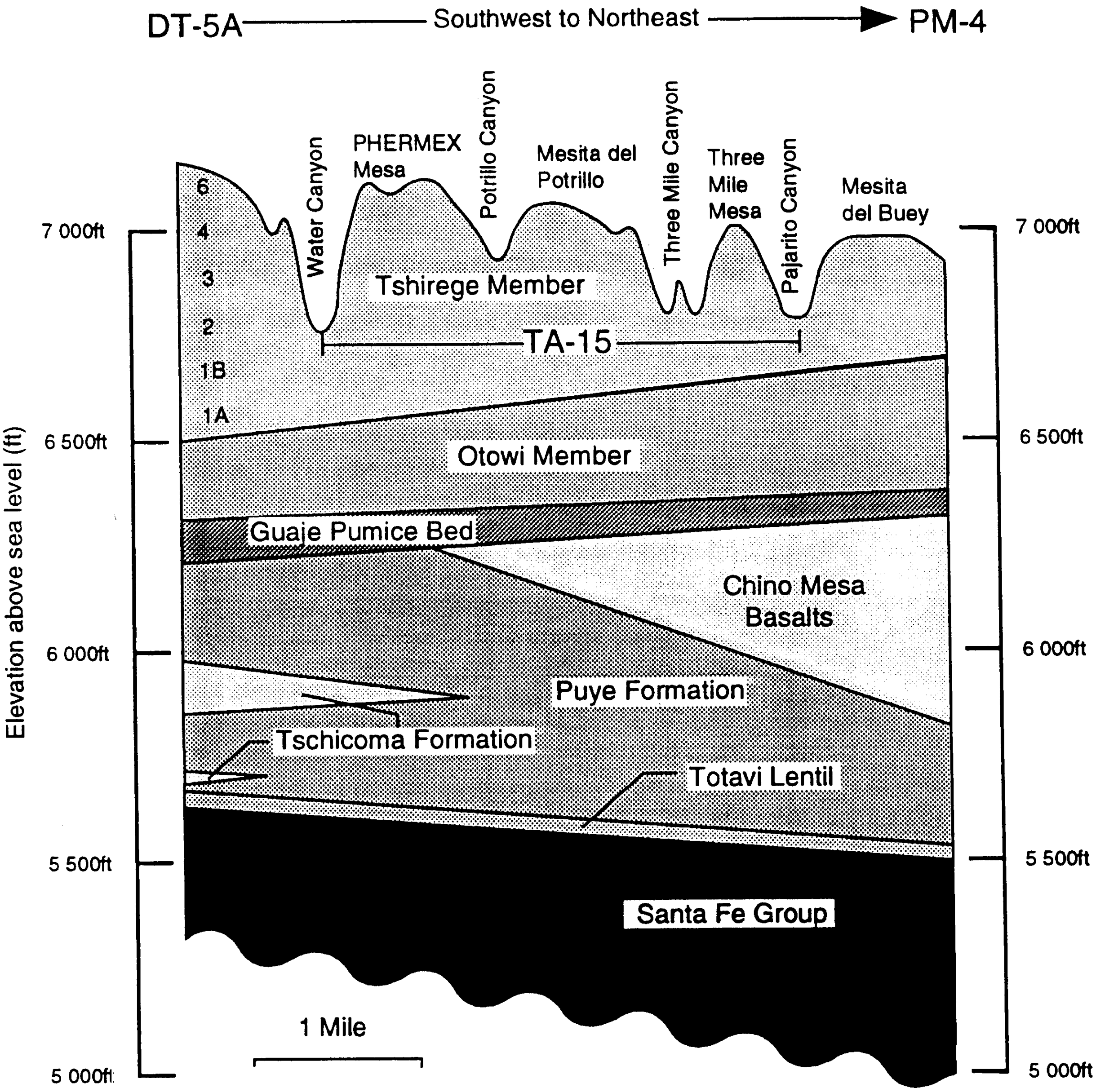


Figure 3.4-2 Cross section of stratigraphy with accurate topography at TA-15. DT-5 and PM-4 are drill holes on each side of TA-15.

Although Cerro Toledo Rhyolite is present in adjacent OUs, it is not present at this OU to our knowledge.

The Bandelier Tuff in the vicinity of TA-15 rests unconformably upon a number of interfingered deposits of Pliocene to Pleistocene epochs. The Tschicoma lobate dacite and andesite lava flows of the Tshicoma Formation from the west interfinger with the Puye Formation. The Puye Formation is derived from the Tschicoma volcanic centers located in the northeastern range of the Jemez Mountains. The Puye Formation consists of stream flow deposits, debris flow deposits, volcanic ash and block flow deposits, and ash fall and pumice fall deposits (Waresback and Turbeville 1990, 0543). The Cerros del Rio basalts, flowing into the area from the east interfinger in turn with these two formations. Water wells indicate that each of these may unconformably contact the Bandelier Tuff under TA-15 (Gardner and House 1987, 0110).

The Totavi Lentil, a coarse, poorly consolidated channel conglomerate deposited by the ancestral Rio Grande, forms a boundary at the base of the Puye between it and the Santa Fe Group sediments. The Santa Fe Group is a sedimentary rift deposit consisting of fluvial sandstone, siltstone, conglomerates, eolian deposits, ash beds, and lacustrine sediments of Miocene and younger age. The deep groundwater system in the Los Alamos area lies in the Puye and the Santa Fe formations.

Figure 3.4-2 is a cross section between two wells, PM-4 and DT-5A (see Figure 3.4-3 for locations). These wells provide some stratigraphic control for the eastern part of TA-15. No stratigraphic control exists between the two wells; therefore, the interfingering of Tschicoma, Puye, and Chino Mesa rocks is shown schematically. The Tshirege is differentiated into subunits for well DT-5A but not for PM-4. As the Tshirege Member encompasses the TA-15 area and is the only rock exposed at the surface, some details of the petrology and stratigraphy of this unit are included in the following discussion.

The Tshirege Member comprises seven units (Weir and Purtymun 1962, 0228): 1A, 1B, 2, 3, 4, 5, and 6. The best exposure of these units occurs in Water Canyon in the vicinity of TA-15 and to the south. Unit 1A overlies the Otowi Member. It is a light gray to light pinkish gray, pumiceous, friable rhyolite tuff. It overlays unit 1B, a light gray to light orange rhyolite ash flow tuff containing lenses of rock fragments and pumice. Unit 2 is a hard, welded, light pinkish-gray to purplish-gray rhyolite tuff overlying 1B. Unit 2 may be divided into 2a and 2b. Unit 2a is a light gray pumice and 2b is a tan to brown weathered tuff (Baltz et al. 1963, 0024). This unit is exposed near the bottom of the deepest canyons in the neighborhood of TA-15, i. e., Water Canyon. Unit 3 is a friable, pumiceous, light gray rhyolite tuff. Unit 4 is a moderately welded, cliff-forming, light-pinkish-gray rhyolite tuff. Unit 5 (not shown in Figure 3.4-2) is a thin deposit, possibly a surge deposit, of coarse sand. Unit 6, the uppermost unit, is a moderately welded, pinkish-gray rhyolite tuff. It forms the upper cliff in the Tshirege in the TA-15 area. Detailed petrology of each of these units may be obtained from Weir and Purtymun (Weir and Purtymun 1962, 0228) who also developed the nomenclature.

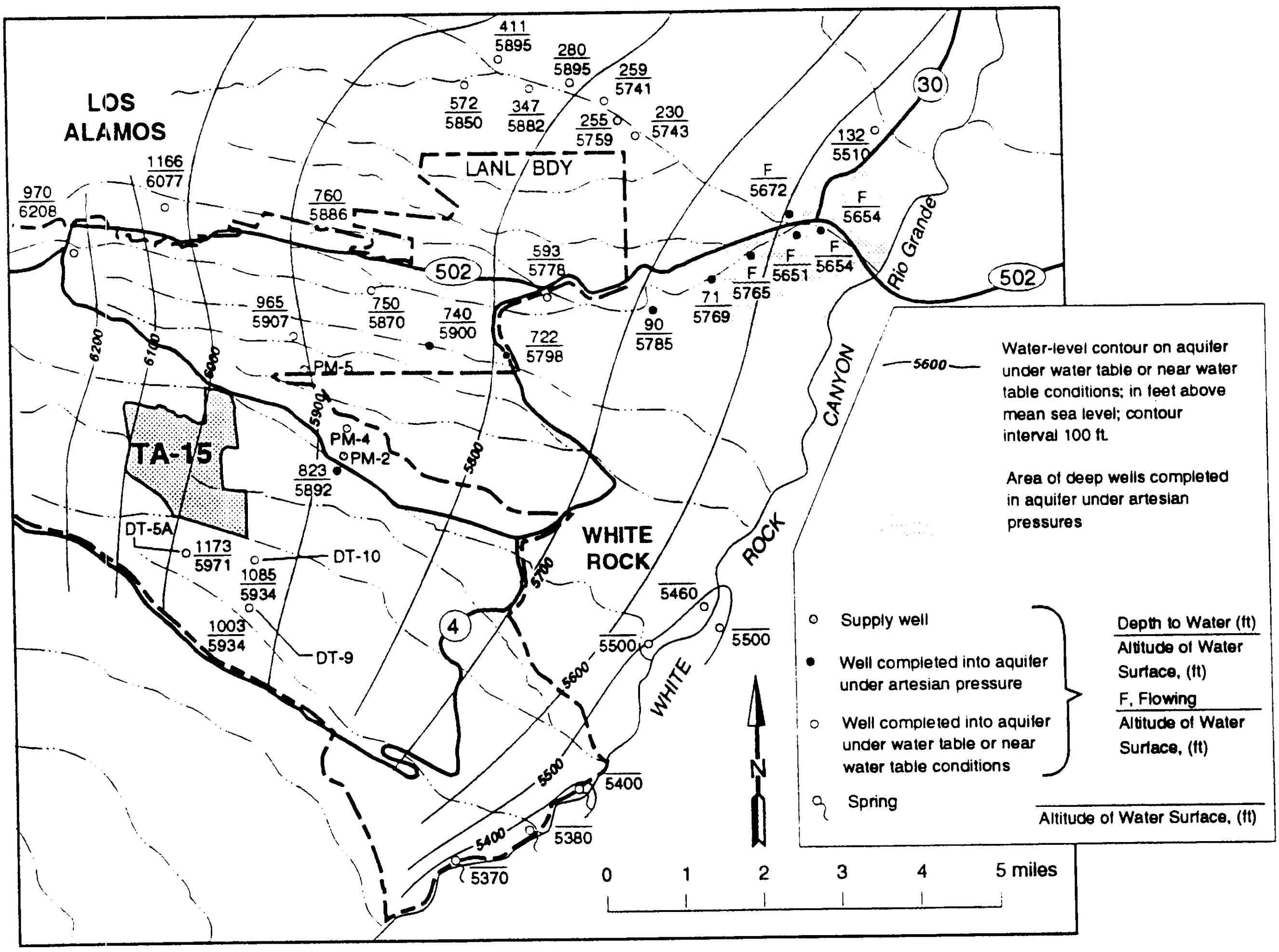


Figure 3.4-3 Surface and groundwater sampling locations within and near the laboratory (Purtymun and Johansen 1974, 0199).

3.4.2 Structure and Seismicity

The Pajarito fault system (Figure 3.4-4), a feature along the western margin of the Rio Grande rift, is a north-south trending feature 3 to 4 km west of TA-15. The faulting is primarily normal with TA-15 on the down-thrown side. Two north-south trending faults, the Rendija Canyon fault and Guaje Mountain fault, branch southward from the Pajarito fault system north of the the Los Alamos townsite. These faults break Bandelier tuff and recent sediments in the north. Seismic studies show they are present at depth just north of TA-15 (Dransfield and Gardner 1985, 0082; Gardner and House 1987, 0110). The fault planes or, perhaps, more feathered fracture patterns may be reasonably thought to lie beneath TA-15. In both cases, the down-thrown side of these faults is to the west. TA-15 lies in a small structural graben. The sharp right lateral turn in Cañon de Valle on the western edge of TA-15 may lie along the surface expression of the Rendija fault zone. An extension of the Guaje Mountain fault zone would pass beneath Mesita del Potrillo as well as PHERMEX Mesa (the mesa on which PHERMEX is located).

3.4.3 Soils

Soil types, characteristics, and locations are described below, as they are not presented in the 1992 IWP.

3.4.3.1 Soil Types and Characteristics

Soil characteristics are not described in any detail in the IWP; therefore, site-specific and general information for TA-15 will be presented here. The primary reference for the following is from Nyhan et al. (1978, 0161). Well-developed soils are located on the level or gently sloping areas of the mesa tops. Formation of such soils with abundant layer lattice clays in such an arid environment as found on the Pajarito Plateau may have taken as much as tens to hundreds of thousands of years.

Characteristics of the various soils are listed in general terms based upon their water-holding capacity, potential for run-off, estimated erosion hazard, and permeability. Water-holding capacity is determined by soil plasticity and available water capacity. Soil plasticity index is the amount of moisture in a soil between two limits: enough for the soil to flow under the slightest applied force and enough for the soil to be rolled onto a wire. Both limits are expressed as a percentage of water content. The second subtracted from the first is the index. Indices range from 5 to 30 (relatively high plasticity).

Available water capacity is expressed in centimeters of water per centimeters of soil. It ranges from 0.02 (gravel) to 0.21 (clay). Run-off is determined by soil properties influenced by the minimum rate of infiltration obtained for a bare soil after prolonged wetting. Soils are grouped (A to D) according to this property. D indicates highest potential for run-off. Erosion factors K and T are measured for the soil. K is a unitless parameter which is a function of texture, soil structure, permeability, and organic matter content. High silt and sand content, for instance, will make soils more susceptible to erosion. K values range from 0.15 to 0.37 at TA-15. High numbers mean more susceptibility to erosion. Soils at

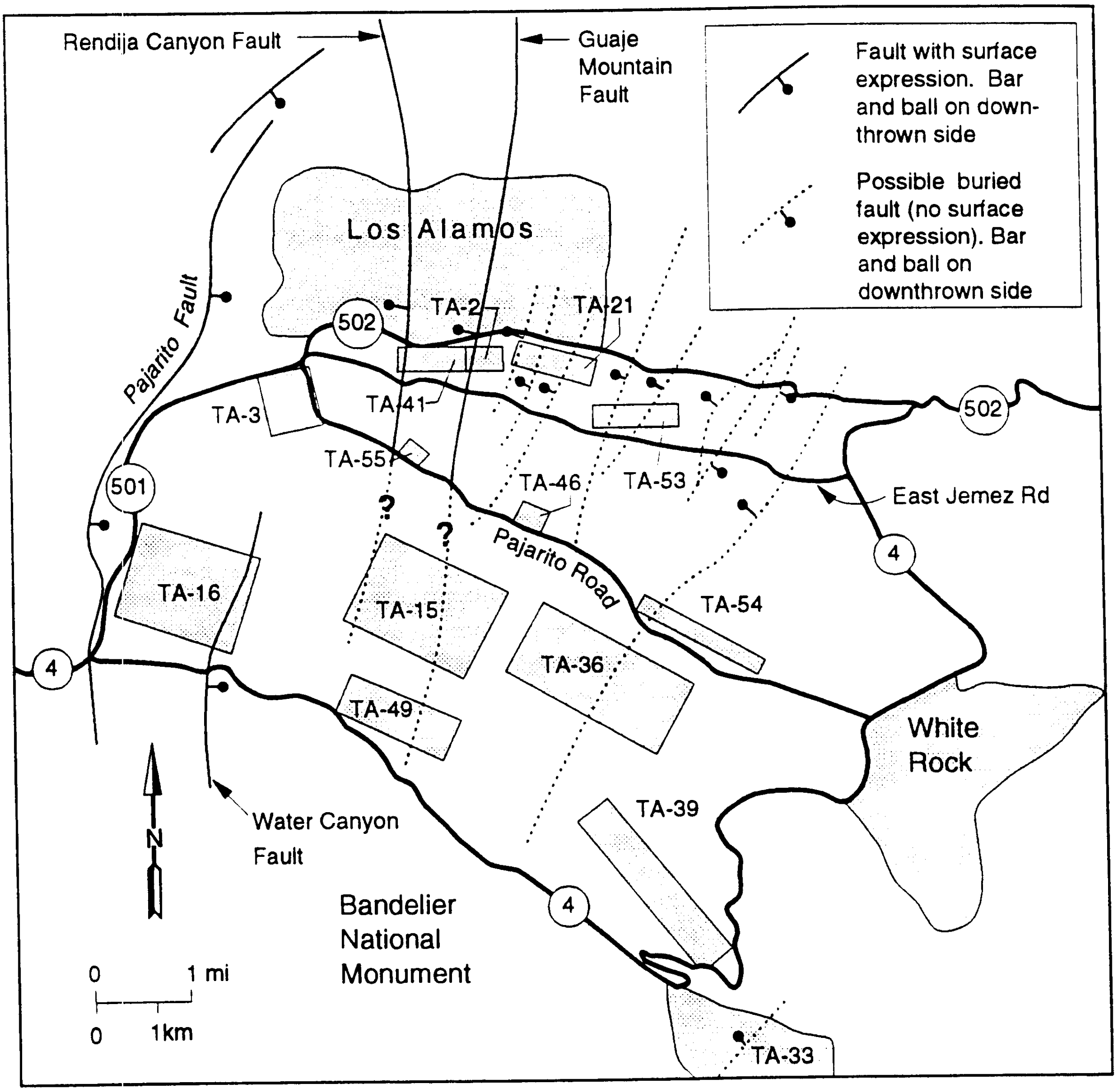


Figure 3.4-4 Faults at selected Laboratory technical areas, Los Alamos, White Rock, and major roads [modified from Dransfield and Gardner (1985, 0082) and Gardner and House (1987, 0110)].

TA-15 appear "moderate" inasmuch as high values for soils are about 0.69. The term T is soil loss tolerance expressed in tons of allowable soil loss/acre/year. These estimated values range from 1 to 5, with larger T values assumed for deeper soils. Wind loss is estimated separately and also calculated in tons/acre/year. Permeability is measured in centimeters per hour and ranges from 0.15 (clay) to greater than 50 (gravel). Other than that for permeability, available measurements are qualitative (imprecise) but yield numbers for relative comparison: low (slow), medium (moderate), or high (fast) in a given category. These more general terms are used in the following description of separate soil units.

The following soils are found at TA-15. See Subsection 3.4.3.2. for location.

Carjo loam: Typical of mesa tops, this loam forms from the weathering of tuff on relatively level ground (loam is a rich permeable soil composed of a mixture of clay, silt, sand, and organic matter). A typical mesa-top surface layer is a grayish brown loam with a subsoil that is more clayey. Depth is typically 50 to 100 cm to the tuff interface. Water-holding capacity, run-off, and erosion hazard are medium compared with other soils.

Frijoles loam: Characteristic of soils formed from pumice, this loam forms on level to moderately sloping mesa tops. The soil grades downward from a brown sandy loam, through a clay layer, to a gravely clay (plus or minus sand) loam which contains pumice. Depth to pumice is about 45 cm. Underlying pumice has some clay content. Permeability is low in the loam and fast underneath. Water capacity is low, run-off is medium, and susceptibility to erosion is moderate.

Hackroy loam: This is a shallow soil formed from tuff. Hackroy rock outcrops contain this loam with typically 70% rock (Tshirege Member) outcrop. Hackroy soil is a brown sandy loam grading to gravely or clayey loam with depth. Depths are usually less than 30 cm to tuff. Both units exhibit low permeability and low water capacities. The loam has medium run-off and moderate water erosion hazard. The rock unit has moderate to severe erosion hazard and medium to high run-off.

Nyjack loam: This is soil derived from weathered tuff on level to gently sloping terrains. Brown loam is on the surface, then brown clay. The substratum is gravely sandy loam which may contain 30% pumice. Depth to bedrock is 50 to 100 cm. Water capacity and permeability are medium. Erosion susceptibility is slight.

Pogna loam: Soil is made from tuff on gently to strongly sloping mesa tops. Light brownish gray sandy loam is on the surface over tuff with at most 50 cm depth. Water capacity is low, permeability is moderate, run-off is medium, and water erosion can be moderate.

Seaby loam: Forming on gently to moderately sloping mesas, Seaby loam is also formed on weathered tuff. The surface is a brown sandy loam grading into a brown to strong brown gravely clay loam with 35% to 70% pumice. The substratum is a white gravely pumice with thin layers of brown clay loam, with a total depth of as much as 66 cm. Permeability is moderate in the upper soil and very rapid below. Water capacity is low and erosion rates are moderate.

Tocal loam: This loam is a shallow soil on weathered tuff with gently to moderately sloping aspect. It is a grayish brown, very fine sandy loam with a subsoil of reddish brown clay loam or clay and a substratum of a light brown silt loam. Depth to tuff is 20 to 50 cm. Permeability is moderately low and water capacity is low. Run-off is medium and water erosion is moderate.

Typic eutoboralfs fine: This soil is formed in colluvium and material weathered from tuff. Colluvium is a loose, incoherent deposit at the base of a cliff, usually formed by gravitation. Slopes may be gently to moderately sloping and are usually located downhill from fault zones. The surface layer is a light gray silt loam or loam. The subsoil is a reddish brown, gravely or cobbly clay or clay loam. The depth can be 120 cm and more. Permeability is low; water capacity is slow; run-off is slow to medium; and erosion susceptibility is moderate.

3.4.3.2 Soil Type Location

Soil in this context will refer to surface deposits which include colluvium and alluvium. Coverage is very variable over TA-15 (see Appendix B for soils map) The progression from the north of TA-15 to the south is described in the following paragraphs.

The extreme northern portion of TA-15 starts at the bottom of Pajarito Canyon and consists primarily of rock outcrops which are discussed in Subsection 3.4.1, Stratigraphy. The surface of Pajarito Mesa is covered with Frijoles very fine sandy loam. The southern part of this mesa shows exposures of Hackroy rock outcrop complex.

Three-Mile Canyon has steep rocky walls with some gravely sandy loam (Totavi) in the bottom of the canyon. The eastern tip of Three-Mile Mesa exposes Hackroy rock outcrop complex, grading westward into Carjo loam and Pogna sandy loam. Still further to the west lie Seaby loam and the continuation of Carjo loam. In general, Carjo loam is central to the Mesa throughout its length and is joined by Seaby loam in the west.

The eastern portion of Mesita del Potrillo, which joins Three-Mile Mesa to the west, is covered with Hackroy rock outcrop complex in the extreme eastern edge, grading into Carjo loam, which persists to the western edge of TA-15, where it is joined on the eastern margin of Cañon de Valle by Pogna loam. The northeastern rim of Mesita del Potrillo is covered with Hackroy sandy loam.

The sequence of soils on the land bridge connecting Mesita del Potrillo with the mesa on which PHERMEX is located has the following progression of soils from west to east: Pogna loam, a pod of Frijoles loam, Seaby loam, and Carjo loam, with typic eutroboralfs at the head of Potrillo Canyon. Grading west to east into Potrillo Canyon one finds Tocal loam and, in the bottom of the canyon, Totavi sandy loam.

The center of PHERMEX Mesa is covered by Nyjack loam. This grades to the north to Seaby loam and Hackroy loam on the northeast rim of Potrillo Canyon. Seaby grades to the west and east of PHERMEX site with a small pod of Nyjack located on the extreme eastern edge of TA-15 on this mesa. The northern rim of Water Canyon shows Pogna loam on the west and Hackroy loam on the east. A pod of Seaby loam is located in the bottom of Water Canyon at the eastern edge of TA-15.

3.5 Hydrology

The following subsections discuss surface water, the vadose zone and its properties, and groundwater.

3.5.1 Surface Water

Surface water hydrology is the science concerned with the transfer of water over the earth's surface. Examination of an equation of the surface water hydrologic budget reveals that water derived from precipitation does not all appear as streamflow. Precipitation that falls on the ground may go into storage on the surface or into soil and groundwater reservoirs, be taken up by plants and transpired, and evaporate or sublimate back into the atmosphere. Surface water transport almost certainly is one of the predominant mechanisms for redistributing many of the contaminants at OU 1086. Important contaminant transport mechanisms associated with surface water include

- Erosion and sedimentation (sediment and contaminant accumulation) of soils, rock, waste piles, contaminants on the ground surface, and buried contaminants;
- Infiltration of surface water that may itself be contaminated or movement of precipitation through a contaminated deposit that in turn transmits contamination deeper into the soil/rock profile;
- Movement of contaminants in surface water that discharges in the dissolved, suspended sediment, and bedload phases.

3.5.1.1 Location of Surface Water at OU 1086

Surface water flow begins with the progressive accumulation of overland flow into rills, rivulets, and small channels, which collect and funnel flow into large-scale, well-defined stream channels of delineated watersheds. Springs and man-made outfalls can also contribute. Four separate watersheds, each with an established stream channel drainage network, are present within OU 1086. These watersheds are Three-Mile Canyon, Potrillo Canyon, Water Canyon, and Cañon de Valle; their locations and boundaries with respect to OU 1086 are shown in Topographic Map Appendix A. (A fifth watershed, Pajarito Canyon, received runoff from a small, undeveloped area within OU 1086. Because it is not expected that the watershed will receive any contaminants from OU 1086, it is excluded from further discussion.) All surface water transport of contaminants at OU 1086 ultimately will flow into one of these four canyons.

Examination of the contaminant source term with respect to the watershed boundaries will enable prediction of which canyon will receive the contaminant. Three-Mile Canyon flows into Pajarito Canyon; Potrillo Canyon and Cañon de Valle flow into Water Canyon; and Pajarito and Water canyons both are tributaries to the Rio Grande. Streamflow in Three-Mile and Potrillo canyons is ephemeral with flow occurring in response to rainfall and snowmelt events. Flow in Cañon de Valle in the vicinity of OU 1086 may at times be from permitted waste water discharge and from snowmelt and stormwater run-off. Water Canyon receives flow from springs upstream from West Jemez Road, from permitted wastewater discharge at TA-11, TA-15, and TA-16, and from snowmelt and stormwater run-off. In years of heavy snow pack, these channels may transport continuous flow during the spring. Intermittent channel flow in response to heavy rainfall occurs during the spring, summer, and fall.

Depth of flow in these channels from snowmelt is generally small, on the order of a few centimeters. Flow from rainfall events can reach depths of 1 m or more. Run-off events of this magnitude can erode and transport large volumes of sediment and contaminants. No direct measurements of flow or sediment discharge have been made in Three-Mile Canyon or Cañon de Valle in the vicinity of OU 1086. Peak discharge measurements in Potrillo Canyon downstream from OU 1086 at OU 1130 were measured as 1.63 m^3/s during 1990.

3.5.1.2 Sedimentation and Erosion

Sediment accumulation and erosion from surface water occurs episodically in response to run-off events, with the greatest amounts occurring during large discharges. Erosion from surface water can expose and transport contaminants from their original disposal location; sedimentation can redeposit the contaminant of interest to another location within a watershed, either within or beyond the Laboratory boundary. Sediment accumulations in excess of 1 m from a single event have been measured in the active channel in Potrillo Canyon east of OU 1086. There have been no comprehensive sediment budget analyses performed on the Pajarito Plateau.

Erosion is expected to accelerate over areas where the natural soil surface has been disturbed, such as roads, firing site pads, burial pits, boneyards, and open dumps. Disturbed soil can increase surface run-off and make soil susceptible to erosional processes (Graf 1975, 0847; Nyhan and Lane 1986, 0159).

Uranium, a heavy metal used in dynamic weapons testing at OU 1086, was found to accumulate in particular geomorphologic deposits in Potrillo Canyon (Becker and Hoopes, 1993, in preparation). There is preferential accumulation of the smaller particulates in the stream bank deposits, point bars, and alluvial fans. Therefore, these geomorphologic deposits are expected to accumulate uranium and other contaminant metals, such as mercury, lead, and possibly beryllium.

3.5.1.3 Infiltration of Surface Water

Infiltration of surface water can occur in several different hydrologic settings. These include

- Native and disturbed soils,
- Exposed rock surfaces, and
- Active stream channels in the watersheds.

In general, significant infiltration into soils on mesa tops and through rock surfaces on mesa tops and in steep canyon walls is not expected to occur, for reasons summarized in Chapter 2 of the IWP. Contributing areas for surface water flows in these areas are insufficient to generate sufficiently large volumes that could then percolate to great depths; evapotranspiration limits the depth of infiltration in these settings on the Pajarito Plateau, and the underlying Bandelier Tuff has a large storage capacity. Results from several experiments in which water was artificially introduced into the soil did not indicate free water movement to great depths. (Abrahams et al. 1961, 0015). However, no site-specific measurements have been made of infiltration at OU 1086.

3.5.1.4 Slopes Analyses

Slopes are an important factor in the evaluation of contaminant transport because contaminant dispersion will occur more rapidly as the slope increases. Overland flow velocities (discharges) will increase proportionally to the square root of the slope over which flow occurs. A rapidly moving flow has less opportunity to infiltrate into the soil, and therefore has decreased potential to move contaminants vertically into the soil. Increased flow velocities have a greater capacity to erode sediments and transport contaminated sediment, particulates, and contaminants in the liquid phase away from their original disposal site. Gentle slopes tend to retard overland sediment movement. The shallow slope can permit increased infiltration of a contaminant vertically into the soil, which could then carry the contaminant to depth, either in dissolved or particulate phases.

There is a wide variation in slope in OU 1086 (Appendix A). Slopes on the mesa tops are typically about 2%. Steeply sided canyon walls that form the interface between the mesas and canyon bottoms range from 30% to 90%.

3.5.2 A Description of the Vadose Zone and Its Properties

The Pajarito Plateau is characterized generally by elongated mesas separated by canyons from 30 to 150 m deep. The mesas have thin soil mantles (see Subsection 3.4.3 of this OU work plan), whereas canyon bottoms have alluvial fill ranging from 0 to nearly 30 m thick. Underlying the soils and alluvial fills is a thick sequence of Bandelier Tuff. With the exception of possible small alluvial and perched aquifers in some of the canyon bottoms that receive perennial flow or substantial volumes of wastewater effluent, or both, unsaturated flow conditions are believed to predominate throughout the Bandelier Tuff down to the top of the main aquifer.

3.5.2.1 Moisture Movement in the Vadose Zone

As summarized in the IWP, most precipitation that falls on the ground is evaporates and/or transpires back to the atmosphere before it reaches the Bandelier Tuff. On the mesa tops a clay layer at the bottom of the soil horizon aids in restricting further downward movement of water into the underlying tuff. Where the soil has been removed or disturbed, water will move vertically into the tuff. At depths in excess of 10 m, the moisture of the upper tuff units rarely exceeds 10% saturation. At this moisture level, flow can occur only under unsaturated conditions. As the moisture content declines, water will move by capillarity.

An injection well experiment was conducted on a mesa top adjoining Mortandad Canyon several kilometers to the northeast (Stoker et al. 1991, 0715). Gravity flow dominated moisture movement at high moisture content during the injection phase. After injection of water ended, the moisture content decreased, and water movement slowed to virtually zero when the moisture content reached the specific retention of the tuff. Downward and outward movement continued under capillary forces (matric potential). Matric potential is measured in units of pressure head that are below atmospheric levels (negative pressure head).

3.5.2.2 Vadose Zone Soil and Rock Properties and Moisture Characteristics

No measurements have been made on soil and rock properties and moisture characteristics at OU 1086. The following subsections summarize data collected from coreholes in Mortandad Canyon that were completed below an alluvial aquifer and from areas in Sandia and Mortandad canyons where there is no alluvial or perched water present. Coreholes completed below an alluvial aquifer are designated MCM 5.1 and MCC 5.9A. Coreholes 6, 7, and SIMO-1 were completed where there was no alluvial aquifer present. Information on these holes is discussed in the following subsections and is summarized from Stoker et al. (1991, 0715) and (Stevens and Associates 1991, 10-0031).

3.5.2.2.1 Porosity

Values of porosity as a function of lithology as measured in the corehole SIMO-1 were 55% to 56% in Unit 1A, 41% to 62% in the Tsankawi, and 44% in the Otowi. Porosity values from corehole MCM 5.1, completed through a shallow alluvial aquifer in Mortandad Canyon, varied from 41% to 49% in alluvium, from 29% to 60% in weathered Unit 1A, 50% to 63 % in unweathered Unit 1A, and from 35% to 48% in the Tsankawi.

3.5.2.2.2 Hydraulic Conductivity

Unsaturated hydraulic conductivity data measured on cores from boreholes in Mortandad Canyon varied from 10^{-6} to 10^{-11} cm/s in the Bandelier Tuff, and increased to 10^{-3} to 10^{-2} cm/s at the contact between the Tsankawi and the Otowi units, a region of moisture accumulation. Saturated hydraulic conductivity ranged between 5×10^{-5} to 2×10^{-3} cm/s in areas below the alluvial aquifer (Stoker et al. 1991, 0715).

3.5.2.2.3 Moisture Content

Gravimetric moisture measurements were made on samples collected in boreholes in Mortandad and Sandia canyons. Results indicated that the moisture content below the alluvial aquifer varied from 10% to 30%. Gravimetric moisture increased to a peak in the Tsankawi just above and at the contact with the Otowi at about 60%, then declined in the Otowi to 12% to 18%. Maximum moisture content in wells that were not completed into the Otowi or beneath alluvial aquifers was 32%.

3.5.3 Groundwater

3.5.3.1 Shallow Perched and Alluvial Aquifers

Little drilling has been done to confirm or deny the presence of perched or alluvial aquifers in Three-Mile Canyon, Potrillo Canyon, Cañon de Valle, or Water Canyon. However, based upon the geology and hydrology of these canyons and observations made in other canyon locations where there is sufficient information on the existence of perched and alluvial aquifers, the following generalizations appear to be reasonable. The issue of alluvial aquifers is addressed by Purtymun and Stoker (LANL 1991, 0553) in the 1991 IWP, Appendix M.

Three-Mile Canyon has a small drainage area that heads on the Pajarito Plateau; ephemeral streamflow in the canyon occurs in response to snowmelt run-off and from storms during the spring, summer, and fall. The presence of a permanent perched or alluvial water in this canyon is considered unlikely.

Potrillo Canyon heads on the Pajarito Plateau at TA-15. Streamflow in the channel is in response to snowmelt and run-off from storm events in the spring, summer, and fall. The stream channel in the upper reaches of the watershed (in OU 1086) is cut directly on the Bandelier Tuff. There is little to no alluvial fill in this reach of the watershed. Therefore, it is unlikely that a permanent alluvial exists in this canyon. Becker (1991, 0699) found no alluvial aquifers in the watershed further downstream where streamflow discharge is greater due to a larger contributing area.

Cañon de Valle heads on the flanks of the Sierra de los Valles. Cañon de Valle receives small amounts of recharge from springs in its uppermost reaches but, because of evapotranspiration and infiltration, streamflow from this source does not reach West Jemez Road. Cañon de Valle receives effluent from permitted wastewater discharge in the reaches below West Jemez Road but above OU 1086. Some streamflow is maintained in the direct vicinity of these effluent discharges, but are rapidly depleted by evaporation, transpiration, and infiltration. Streamflow through OU 1086 is ephemeral and occurs in response to snowmelt run-off, and run-off from spring, summer, and fall precipitation.

Water Canyon is a large canyon that heads on the flanks of the Sierra de Los Valles. Several springs discharge from perched layers in the tuff in upper Water Canyon and the largest of these springs has been used to supply water to S-site in the past. Water Canyon also receives wastewater discharge from TAs-II, 15, 16, and 37. A short distance downstream from the confluence of Water Canyon and Cañon de Valle is Beta Hole, a dry well extending 187 ft into the Bandelier Tuff. Two other shallow wells completed into the alluvium were drilled in Water Canyon, one of which is located on OU 1086. These wells are also dry. The lack of water in these wells confirms that Water Canyon in the vicinity of TA-15 contains no permanent perched or alluvial aquifers. There is a possibility of perched zones on interfingers of basalts at intermediate depth.

3.5.3.2 The Main Aquifer

As summarized in Chapter 2 of the IWP, the main aquifer is the only aquifer capable of supplying municipal and industrial water needs. The upper surface of the Main Aquifer rises to the west from the Rio Grande through the Santa Fe Group into the lower part of the Puye Conglomerate beneath the central and western parts of the Pajarito Plateau. The water in the aquifer moves in a general sense from the main recharge area in the Valles Caldera on the west side of the Sierra de Los Valles eastward towards the Rio Grande, where there is some discharge into the river through seeps and springs. As stated earlier, there are no wells at TA-15. Therefore, all inferences on the Main Aquifer beneath this technical site have been drawn from information derived from supply wells PM-2, PM-4, and PM-5 as well as the three deep wells at TA-49, DT-5A, DT-9, and DT-10 (Figure 3.4-3).

The aquifer beneath TA-15 is located stratigraphically with the basaltic rocks of Chino Mesa and interflow breccia, in the Puye Conglomerate, and in the Santa Fe Group. These units are composed of basalts, interflow breccias; conglomerates; and sandstones, conglomerates, basalts interflow breccias, and siltstones; respectively. Not all of these rocks transmit water equally well. Thick basalts, siltstones, and fine-grained sandstones will not yield water as readily as coarse-grained conglomerates and sandstones, highly jointed basalts, and coarse sediments of interflow breccias. To maximize production, supply and test wells are screened through a thick section of the aquifer to draw from multiple, highly permeable layers.

The depth to the main aquifer beneath TA-15 water is estimated to vary from about 875 to over 1100 ft (Purtymun and Stoker 1988, 0205), with depths increasing to the west and from valley bottoms to mesa tops. Aquifer hydrologic characteristics vary.The closest well to TA-15, designated as PM-2, is in Pajarito Canyon. All wells are open in the Puye Conglomerate and Santa Fe Group. The characteristics of the wells are listed in Table 3.5-1.

TABLE 3.5-1
CHARACTERISTICS OF WELLS NEAR TA-15 *

Well	Saturated Thickness (ft)	Specific Capacity (gpm/ft)	Transmissivity (gpd/ft)	Field Coefficient of Permeability (gpd/ft^2)
PM-2	1426	23.1	40 000	28
PM-4	1828	36.8	44 000	24
DT-5A	643	5.7	11 000	17
DT-9	498	22	61 000	122
DT-10	324	16	36 100	111

* From Purtymun 1984, 0196.

The water levels in the Main Aquifer have declined: 25 ft at PM-2 since 1966 and 34 ft at PM-4 since 1984. The water levels in DT-10 and DT-5A have declined about 0.5 ft/yr. (Purtymun 1984, 0196). A detailed description of the latter wells is given in the RFI Work Plan for Operable Unit 1144 (TA-49).

As described by Purtymun (Purtymun 1984, 0196), the Main Aquifer is sensitive to atmospheric pressure changes, earth shocks, and probable earth tide effects, as monitored by a continuous water stage recorder on test well DT-9. Possible earth tide effects result in minor water level fluctuations (0.01 to 0.03 ft) when the gravitational pull of the moon elongates and compresses the aquifer. Strong earth motions have been recorded. The 1964 Good Friday Alaskan earthquake caused a water level fluctuation of more than 1 ft at well DT-9. These earth motion fluctuations are caused by the expansion and compaction of the aquifer by an earthquake's surface waves. Boreholes and wells completed in the Bandelier Tuff and Puye Conglomerate transfer air to and from the Tuff and Conglomerate in response to changes in atmospheric pressure. Wells will "exhale" during barometric lows and "inhale" during barometric highs. Water level fluctuation is usually less than 0.5 ft. Because the aquifer at DT-9 is composed of three different formations – conglomerates, basalts, and sandstones – each with a different transmissivity and pressure heads, the variation in the barometric fluctuation is influenced by all three layers.

3.6 Hydrogeologic Model

The following section will describe and review the hydrologic behavior of watersheds on the Pajarito Plateau. Much of this information has been summarized from Becker (Becker 1991, 0699). The term "hydrogeologic model" here is used to describe the hydrologic interactions between the surface and infiltration into subsurface, including the vadose zone, alluvial, perched, and main aquifers. A brief description of the atmospheric hydrologic processes is included for completeness.

3.6.1 Conceptual Hydrogeologic Model

Precipitation falls on a watershed as snow and as rain. Snowmelt normally produces low discharge rates over several months during the spring. Much of the snow either sublimates or melts and evaporates, or infiltrates into the soil profile before reaching the channel. Infiltration losses occur into the channel bed as well. Forty percent of the annual precipitation falls as rain, primarily during the summer months. For run-off to be produced in the channel, there must be significant rain over a number of consecutive days or a major thunderstorm. This is because of the semiarid soil's requirements for moisture replenishment before overland flow can occur. In the large watersheds (Water Canyon and Pajarito Canyon), very large precipitation events or snowmelt from heavy snowpack can produce channel flow which will persist to the Rio Grande. What is more usual is that, during average-sized rain events or moderate to light snowpack, the channel flow will infiltrate into the channel bed and not produce surface flow the entire length of the watershed. This is also the common occurrence in the smaller watersheds such as Potrillo Canyon. It is believed that the quantity of transmission is insufficient to infiltrate through the 500 to over 1000 ft of highly unsaturated tuff to recharge the main aquifer.

In Potrillo Canyon, a particular feature, termed a discharge sink, has been identified and intensively studied (Becker 1991, 0699). A discharge sink is an area where inflow exceeds outflow (if there is any outflow at all), where stream velocities decrease and the flow infiltrates into the channel and valley, where there is no defined channel (only a broad valley), and where there is sediment deposition and aggradation. It is distinguished from areas of temporary sediment storage along the channel by its lack of flow continuity through the area. These sinks can be manmade or naturally occurring. They can be recognized by the lack of a channel through their length, an increased thickness of sediment, or a pattern of sediment fining in the distal direction. They can be, but are not necessarily, topographic depressions.

Such an area exists in Potrillo Canyon approximately 4 km southwest below E-F site in the canyon near the Lower Slobovia firing site bunker (Figure 3.6-1). There is, at present, no defined channel through its length, although the remains of a former channel can be distinguished primarily through vegetation variation between the channel and its surroundings. This discharge sink appears to serve as a giant sponge and sedimentation area absorbing streamflow and trapping all the incoming sediment load. All flow infiltrates into the ground. Downstream there is no evidence of further stream flow. By trapping sediment, the sink serves to contain contaminants, especially heavy metals. The Potrillo Canyon discharge sink has been shown to contain and collect uranium from firing site activities; it has been estimated that outflow has occurred from this area in the past, but has served as a detention area since at least 1968. Because of the large volume of streamflow (up to a million gal. per event) that infiltrates into this rather small area (less than 150 000 m^2), this area potentially could be an area for potential recharge of the main aquifer along the Pajarito Plateau (Becker 1991, 0699).

This discharge sink feature is probably not unique to Potrillo Canyon, but this is the only location on the Pajarito Plateau where such a feature has been identified and investigated. Similar features are postulated to occur in Cañada del Buey (Becker 1991, 0699), and in Mortandad Canyon. The major difference

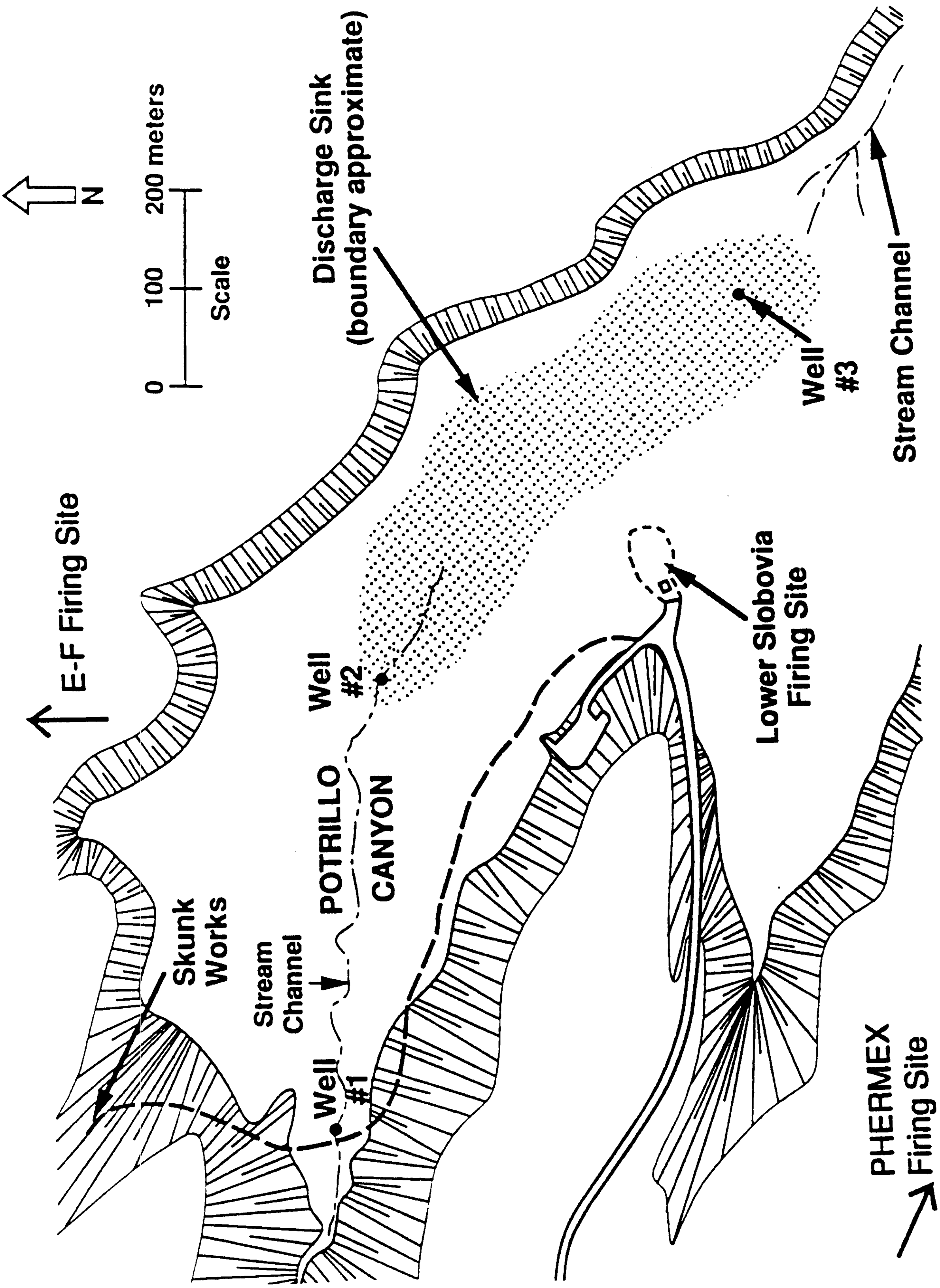


Figure 3.6-1 Discharge sink in Potrillo Canyon where runoff from OU 1086 may be channeled.

between Potrillo and Mortandad canyons is that a shallow alluvial aquifer has been enlarged (and contaminated) as a result of the recharge from outfalls into Mortandad Canyon, whereas in Potrillo Canyon there is no shallow alluvial aquifer development.

There is no evidence that saturated conditions extend to the main aquifer and there is also no evidence to suggest that vapor phase transport is a likely pathway for contamination of the main aquifer. It is known, however, that streamflow can recharge shallow alluvial aquifers, such as exist in Pajarito and Mortandad canyons, and streamflow can also recharge deep perched aquifers, as have been identified in Pueblo, Los Alamos, and Sandia canyons.

3.6.2 Hydrologic Modeling

Modeling of surface, vadose zone, and groundwater flow at Los Alamos is in the development stage. Surface water flood frequency has been modeled with HEC-1 and HEC-2 (McLin 1992, 0825) and surface water flow and plutonium transport have also been modeled (Lane et al. 1985, 0140), although neither of these investigations attempted to duplicate hydrographs and therefore closely simulate the fluid dynamics of open channel flow in the Los Alamos region. Earlier geohydrologic modelling studies are documented in the 1992 IWP (LANL 1992, 0768).

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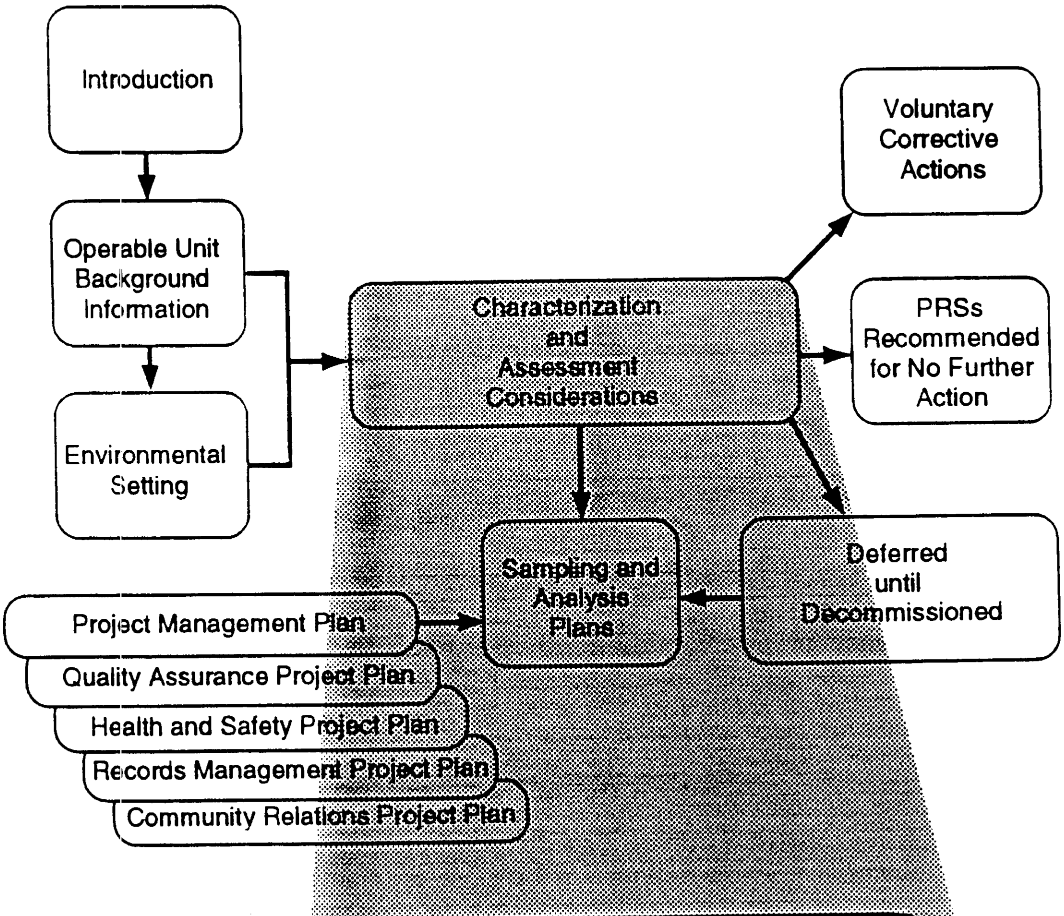
CHAPTER 4



Assessment

- Technical Approach
- Conceptual Model
- Decision Process
- Guidelines for Cleanup By Risk Assessment
- DQO Process
- Field and Analytical Requirements

4.0 CHARACTERIZATION AND ASSESSMENT CONSIDERATIONS

This chapter contains a discussion of characterization and assessment considerations pertinent to the development of the Operable Unit (OU) 1086 work plan. Sections of Chapter 4 are listed below.

- 4.1 Technical Approach
- 4.2 TA-15 Conceptual Model
- 4.3 Health-Based Preliminary Remediation Goals
- 4.4 Decision Process
- 4.5 Implementation of Decision Process
- 4.6 Data Quality Objectives Process
- 4.7 Field and Analytical Data Quality Requirements

The information described under these categories, combined with the environmental setting discussed in Chapter 3, leads directly to the recommendations for no further action (NFA) in Chapter 5 and the characterization plans in Chapters 5 through 10.

4.1 Technical Approach

The Installation Work Plan (IWP) outlines several conceptual elements of the technical approach, as summarized below, which are employed generally in the Environmental Restoration (ER) Program and which have been used in the development of the OU 1086 work plan.

4.1.1 Sequential Sampling and Work Plan Phases

Field sampling plans in this work plan are based on the observational approach as used in the sequential sampling concept discussed in the IWP, Appendix H. In general, sequential sampling uses the results from each sample set to determine if additional sets are required and to guide the selection of the subsequent sample set. In this iterative process, each incremental set of samples aids in determining the required number of additional samples and their optimal locations.

Sequential sampling is closely related to the concept of a phased approach to the RCRA Facility Inverstigation (RFI). Only a single phase of work is expected to be necessary for most OU 1086 Potential Release Sites (PRSs) because most PRSs are expected to contain contaminants at levels below screening action levels. Phase I will provide the initial information required for detailed planning of the subsequent phase, if necessary.

4.1.2 Health-Based Risk Assessment

Initially, the Laboratory has performed assessments, when possible, using archival data to set preliminary investigation goals because screening action levels for areas other than residential were not available at the time of writing of this OU work plan for Technical Area (TA)-15. Following the RFI characterization, a final health-based baseline risk assessment will be used to determine the need for remedial action. The OU 1086 RFI is designed to provide risk assessment data for both radiological and nonradiological contaminants at individual SWMUs and over the entire operable unit.

4.1.3 Integration of the OU 1086 RFI with Other Laboratory-Wide Environmental Activities

To the maximum practical extent, the OU 1086 RFI work plan has been integrated with other Laboratory-wide environmental activities. In particular, the ER Framework Studies Program and the Laboratory's Environmental Surveillance Program have strongly overlapping interests with this RFI. The OU 1086 RFI will also be integrated with work plans being developed for adjacent TA-49 (OU 1144), TA-36 (OU 1130), and TA-16 (OU 1082) in 1992 and 1993, and for the canyons assessment work plan (OU 1049) to be developed later. Data needed for the OU 1086 RFI that overlap with other environmental activities are pointed out in this work plan.

RFI coordination with non-ER operations at TA-15 is also required. Because both current and planned use of TA-15 for on-site Laboratory operations is extensive and the activities are located nearby or on PRSs, the impact of the non-ER site activities on the RFI may be large. Therefore, the RFI must be coordinated with current TA-15 firing site activities.

4.1.4 General Technical Objectives

The technical objectives of the OU 1086 RFI are summarized below:

- Determine whether contaminants are present at each PRS;
- Identify those contaminants present;
- Determine the vertical and lateral extent of contamination;
- Identify contaminant migration pathways throughout the entire operable unit and for each PRS;
- Acquire sufficient information to allow quantitative migration pathways analysis and health-based baseline risk assessment;
- Provide data necessary for assessing potential remedial alternatives; and
- Provide the basis for detailed planning of the Corrective Measures Study (CMS).

The approaches outlined in the next several sections have been adopted in the OU 1086 work plan so that these objectives can be attained. In addition to these technical objectives, management needs require that the objectives be achieved in an efficient, cost-effective manner and that the RFI be properly coordinated with institutional constraints of the Laboratory.

4.1.5 Individual SWMU Characterization

Because the major hazardous materials within the OU 1086 are uranium, beryllium, lead, and mercury, a combination of discrete sampling of surface uranium and its decay products and metal screening and analysis for lead, mercury and beryllium will be used to define the areas and depths of contamination and to specify migration pathways at individual PRSs. Additional surface and subsurface samples, especially the Material Disposal Areas, MDA-N [SWMU 15-007 (a)] and MDA-Z [SWMU 15-007 (b)] will be used to assess subsurface units. Other contaminants that may be present in smaller quantities at a few specific PRSs include silver salts and acids (from photographic labs); degreasers including chromates; and general laboratory chemicals, including organic solvents.

4.1.6 Field Investigation Methods

Common methodologies applicable to the conduct of OU 1086 RFI activities are summarized in Appendix C of this work plan and are not repeated in the individual PRS sampling plans. Field screening, field laboratory, and analytical laboratory measurements will be used for individual PRSs, as appropriate.

4.1.7 Integration with CERCLA, NEPA, and DOE Orders

Annex I of the IWP discusses the conformance of the RCRA-based ER Program with applicable requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the National Environmental Policy Act (NEPA). Additionally, the ER Program will comply with all other applicable federal acts, state statutes, and Department of Energy (DOE) orders and policy statements as identified in the IWP Program Management Plan.

Appendix J of this work plan contains NEPA documents pertaining to cultural and biological assessments relevant to the OU 1086 work plan. A Natural Resource Damage Assessment (NRDA) will be performed following the RFI.

DOE orders applicable to the Laboratory's ER Program are identified in the IWP Program Management Plan. Compliance with the requirements of these orders is an integral part of Laboratory operations and is ensured through the documented policies, planning, auditing, and work review procedures of the Laboratory.

4.2 TA-15 Conceptual Model

In this section, a site conceptual model of potential contaminant release, transport, and routes of exposure for the TA-15 OU is summarized. The model is based on our present understanding of the TA-15 OU and on considerations developed earlier in this work plan. The generalized model is presented diagrammatically in Figure 4.2-1 and in summary form in Table 4.2-1, and the general data needs for TA-15 are summarized in Table 4.2-2. The relationships among contaminated media pathways and receptors are illustrated in Figure 4.2-2. Key elements in these models include the sources, receptors, transport pathways, and resulting exposure scenarios for each pathway. These issues are developed in further detail in portions of Chapter 5 through 10, where individual PRSs are described in detail and PRS-specific field investigations are developed.

At present, the model for the TA-15 operable unit is conceptual and serves to focus the initial RFI on contaminant sources and environmental factors that can influence transport. When the assessments discussed in the preceding paragraph have been made, the need for application of quantitative mathematical models to describe contaminant transport will be evaluated.

Because Firing Site E-F is believed to contain by far the greatest preponderance of site contaminants, it forms the primary focus for the investigation and is treated by itself in Chapter 7. If data acquired in the initial phase of the RFI demonstrates that a different focus is appropriate, the conceptual model will be revised and investigations in subsequent phases will be planned accordingly.

4.2.1 Land Uses

Land use in and around the Laboratory is described in Section 2.5 of the IWP. The likelihood is high that future land use in the vicinity of TA-15 will not change significantly over the 100-yr period assumed for institutional control (Facilities Engineering Division Planning Group et al. 1990, 0655). However it is unlikely that, at TA-15, the continuance of firing site experiments will last for 100 yrs. Also, land uses outside the Laboratory boundary and in the vicinity of TA-15 are expected to remain stable for the indefinite future. No significant changes in land use at the adjoining portions of Bandelier National Monument (BNM) or in White Rock are expected. Thus, site workers will continue to represent the maximally exposed population at OU 1086.

There are three reasonable future land uses for TA-15:

- Institutional use as firing sites, which is its current use;
- Recreational use if TA-15 reverts back to being part of the National Forest System, or BNM; or
- Laboratory use only, with portions of the site remaining forever under institutional control and excluded from private use.

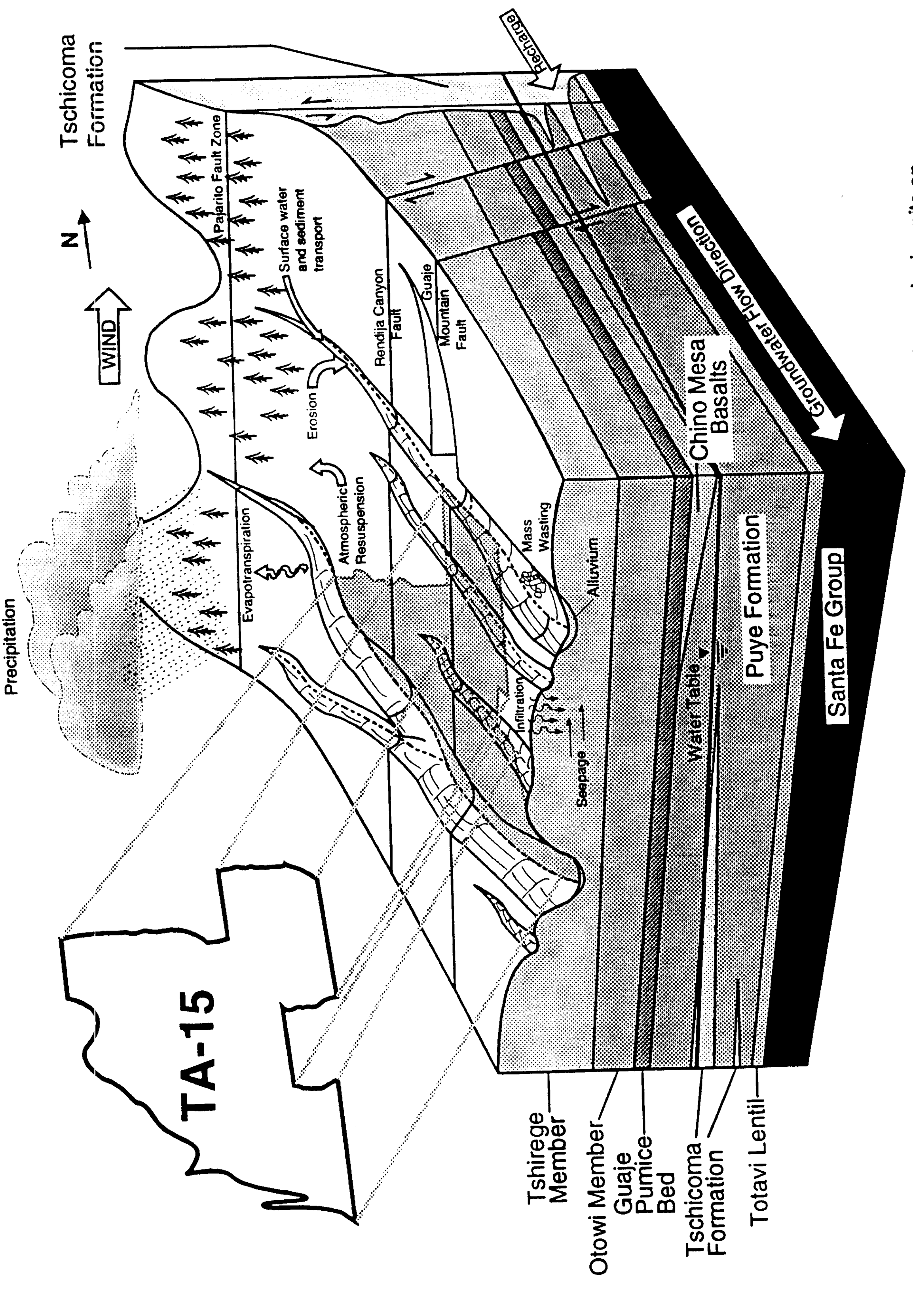


Figure 4.2-1 Conceptual pathways model of OU 1086 showing general relationship of major geologic units on the Pajarito Plateau.

TABLE 4.2-1

SUMMARY OF TA-15 SITE CONCEPTUAL MODEL ELEMENTS

Pathway/Mechanism	Concepts/Hypotheses
Atmospheric Resuspension	• Entrainment is limited to contaminants in surface soils and sediments. • Entrainment and deposition are affected by soil properties. • Atmospheric conditions affecting entrainment, dispersal, and deposition include wind speed, direction, and stability.
Surface Water Run-Off	• Precipitation that does not infiltrate will become surface run-off or will evaporate or transpire. • Surface run-off is concentrated by natural topographic features or manmade divesions. • Local topographic lows can cause water to pond on the mesa top, but most surface water will flow into the canyons. • Solutional contaminant transport by surface run-off can occur, but mass movement by suspended particles or local bed sediments will dominate. • Surface soil erosion and sediment transport is a function of run-off intensity, vegetation, topography, and soil properties. • Contaminant movement will be retarded by sorption onto natural organics, clays, and other highly sorptive phases. • Contaminants dispersed on surface soils can be transported by run-off and concentrated in sedimentation areas of drainages. • Erosion of drainage channels can extend back to the source area.
Alluvial Aquifers	• Ephemeral alluvial aquifers may exist in Water and Potrillo canyons but are unlikely to receive large quantities of contaminants from TA-15.

TABLE 4.2-1 (*Cont.*)

SUMMARY OF TA-15 SITE CONCEPTUAL MODEL ELEMENTS

Pathway/Mechanism	Concepts/Hypotheses
Alluvial Aquifers (*Cont.*)	• Surface run-off in canyons may infiltrate into sediments of channel alluvium. • Flow in alluvial aquifers under saturated conditions will be down-gradient and can be represented by a porous medium continuum model. • Water in alluvial aquifers may enter the underlying tuff. The process will depend on the properties of the interface between the saturated alluvium and unsatu rated tuff, as wll as the properties and pressure head in the unsaturated tuff.
Vadose Zone Transport/Infiltration	• Infiltration into surface soils depends on the rate of rainfall or snowmelt, antecedent soil water status, depth of soil, rate of transpiration, antecedent soil and tuff water content, and soil and tuff hydraulic properties. • Infiltration into the tuff depends on the unsaturated hydraulic properties of the tuff. • Joints and fractures in the tuff may provide additional pathways for infiltration to enter the subsurface regime. • Unit contacts and unit characteristics (e.g. presence of surge unit or degree of welding)) can strongly affect lateral flow. • Movement of contaminants by liquids in the unsatu rated zone would occur primarily by suspended solids. • Fractures may affect liquid transport. Their role is dependent upon soil water content. Above a critical water content, fractures are expected to facilitate flow and transport. Below the critical water content, only unsaturated flow is significant and rock matrix and fill properties will dominate the hydraulic response. • Contaminant movement can be retarded by adsorption onto natural organics, clays, and other sorptive media in the soils and tuff. • Vapor-phase processes are not important for any TA-15 contaminants; volatile TA-15 contaminants are present only in very limited quantities.
Saturated Flow	• Significant saturated flow in tuff is unlikely to be a factor at TA-49

TABLE 4.2-1 (*Cont.*)

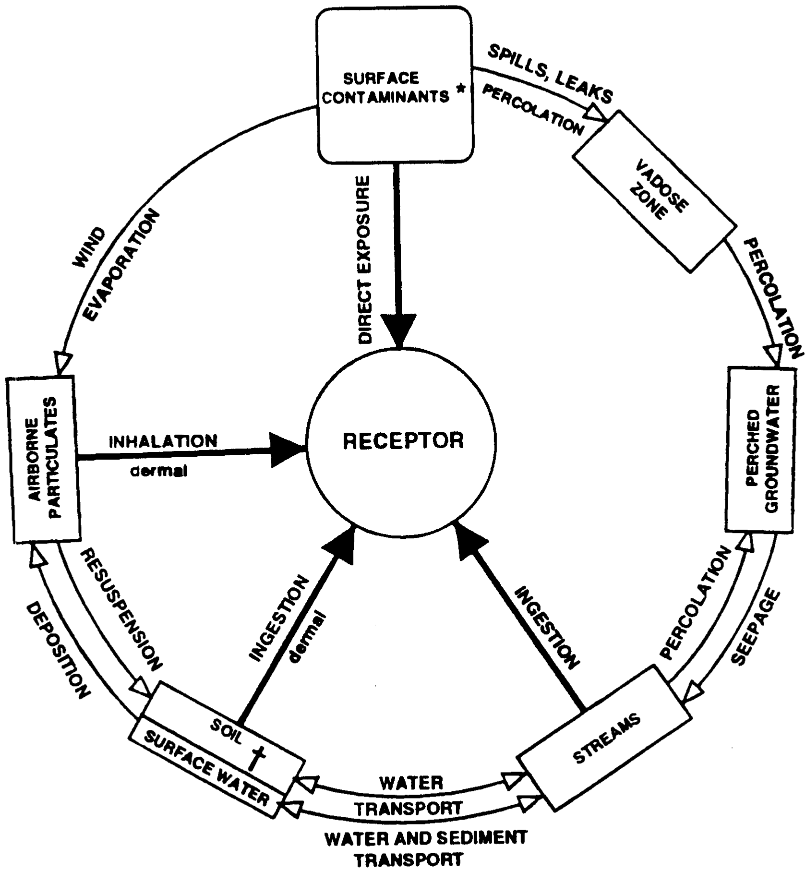
SUMMARY OF TA-15 SITE CONCEPTUAL MODEL ELEMENTS

Pathway/Mechanism	Concepts/Hypotheses
Saturated Flow (*Cont.*)	• Transient rather than steady state conditions may describe the hydraulic character of the near surface, but equilibrium conditions prevail at depths below about 20 ft. • Liquid flow in tuff under ambient conditions can be represented by a porous medium continuum model.
Lateral Flow at Unit Contacts	• Contrast in hydraulic properties between stratigraphic units may divert flow laterally, or may cause a perched water zone to develop. • Laterally diverted flow may find surface expressions as springs or seeps. • Perched water zones may provide localized areas where saturated flow conditions occur.
Erosive Exposure/Soil Erosion	• The erosion of surface soils is dependent on soil properties and vegetative properties, slope and aspect, exposure to wind, and run-off intensity and frequency. • Erosion is controllable by natural and artificial surface features. • Depositional areas as well as erosional areas are determined by the above factors.
Mass Wasting	• The loss of rock from canyon walls is a discontinuous, observable process. • The present rate of mass wasting is too slow to be significant at TA-49, even on a very long time frame.
Biological Transport	• Foraging animals (elk, deer, coyotes, and mice) rep resent the primary biological dispersal mechanism for TA-15 contaminants. • Plant splash and tritium transpiration are also transport methods.
Receptors	• On-site workers represent the maximally exposed populations while institutional control is maintained. • Recreational users are assumed to represent the maximally exposed population if institutional contr[illegible] lost.

TABLE 4.2-2

SUMMARY OF GENERAL DATA NEEDS FOR THE TA-15 OU RFI.

Objective	Data Needed
Contaminant Sources	
1. Identify contaminants at each PRS.	• Verify contaminants at release points
2. Quantify contaminants at each PRS	• Field and laboratory analyses for chemical and radiological contaminants
3. Determine OU-wide background levels in soil, tuff, and groundwater.	• Media background levels for TA-15 contaminants
Contaminant Migration	
1. Identify any migration of contaminants at each PRS.	• Identification of mobile contaminant • Sample analyses along preferential migration paths • Field screening and surveys to guide field work (verified by laboratory measurements)
Baseline Risk Assessment	
1. Identify potential receptors for each pathway.	• Exposure points for each major pathway and human access probabilities • Future land use scenarios
2. Determine contaminant fate and transport.	• Physical chemical data on processes associated with site contaminants, as outlined above
3. Assess contaminant levels against screening action levels and other guides.	• Screening action levels or other applicable guides for site contaminants
4. Assess exposure threat to human health for the no further action remedial alternative.	• Summary of reference doses and slope factors for site contaminants.



* Seeps, streams, and temporary water.
† Pathway of minimal potential risk.

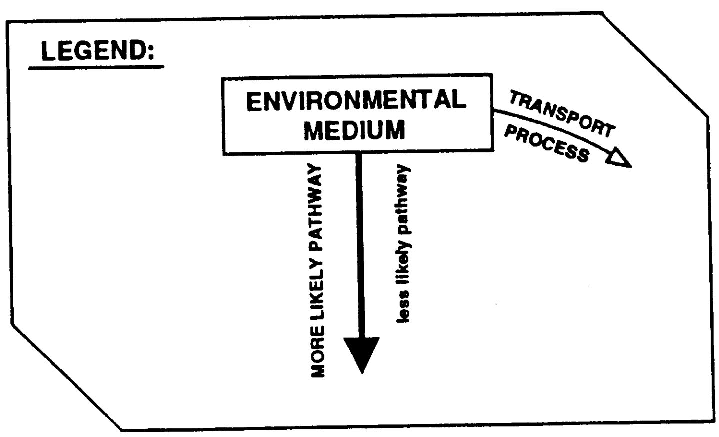


Figure 4.2-2 Conceptual model of surface contaminant transport from the TA-15 OU to potential receptors.

4.2.2 Routes of Exposure and Pathway-Specific Receptors

For each contaminated TA-15 medium identified in Table 4.2-2 and Figures 4.2-2, and 4.2-3, exposure routes for potential receptors are identified. As new data are obtained and assessed in the OU 1086 RFI, the focus on particular exposure scenarios may need to be changed.

At present, the most critical human populations exposed to OU 1086 contaminants are on-site workers. In the case of contaminated surface soils, (and to a lesser extent buried debris), inhalation, dermal contact, external radiation, and incidental ingestion are identified as the most likely human exposure scenarios that need to be considered. Less plausible exposure scenarios involve the ingestion of and dermal contact with contaminated water.

Workers in adjacent technical areas, BNM visitors, State Road 4 travelers, and area residents are much less likely to be exposed to TA-15 contaminants than are on-site workers. Intruder scenarios are assumed to be unimportant in the near term at OU 1086 because of existing very restrictive controls at the site and the distance to points of public access. Likewise, the food chain scenario is assumed to be insignificant for OU 1086 while institutional control is maintained. Large mammals such as deer and elk live on, or pass through TA-15 and nearby technical areas and are sometimes hunted (even though this is illegal).

In the absence of Laboratory control in future scenarios, the exposed on-site human population is assumed to be that connected with recreational use by BNM or national forest area. In addition to the above scenarios, ingestion of contaminated soil and vegetation then becomes a potential exposure mechanism. Human intrusion scenarios such as, deliberately or accidentally drilling into or excavating a Material Disposal Area also would have to be considered if institutional control is lost.

4.2.3 Elements of the Conceptual Model

Key considerations in the OU 1086 site conceptual model are summarized in the following paragraphs. These considerations are addressed for each PRS in Chapters 5 through 10.

Land use/time frame assumptions: Under current land-use patterns in the vicinity of OU 1086, no pathways or receptors other than that of occupational workers are of significant concern over the 100-yr time frame limit for institutional control. However, if land-use patterns change in the future (for example, as a result of land transfer to BNM or national forest) or if dramatic climatic changes occur, long-term exposure pathways such as infiltration or intrusion may need to be considered, see Figure 4.2-3.

Erosional processes: Erosion of TA-15 near-surface units and consequent transport of precipitation by run-off is a potential pathway. Thus, the nature, quantity, and distribution of surface and near-surface contamination need to be characterized in Phase I of the RFI. Aeolian processes represent another low-exposure pathway to be addressed, but they probably are of lesser significance than the surface water pathway. Canyon retreat processes are too slow to be of significance for contaminant transport even over very long time frames.

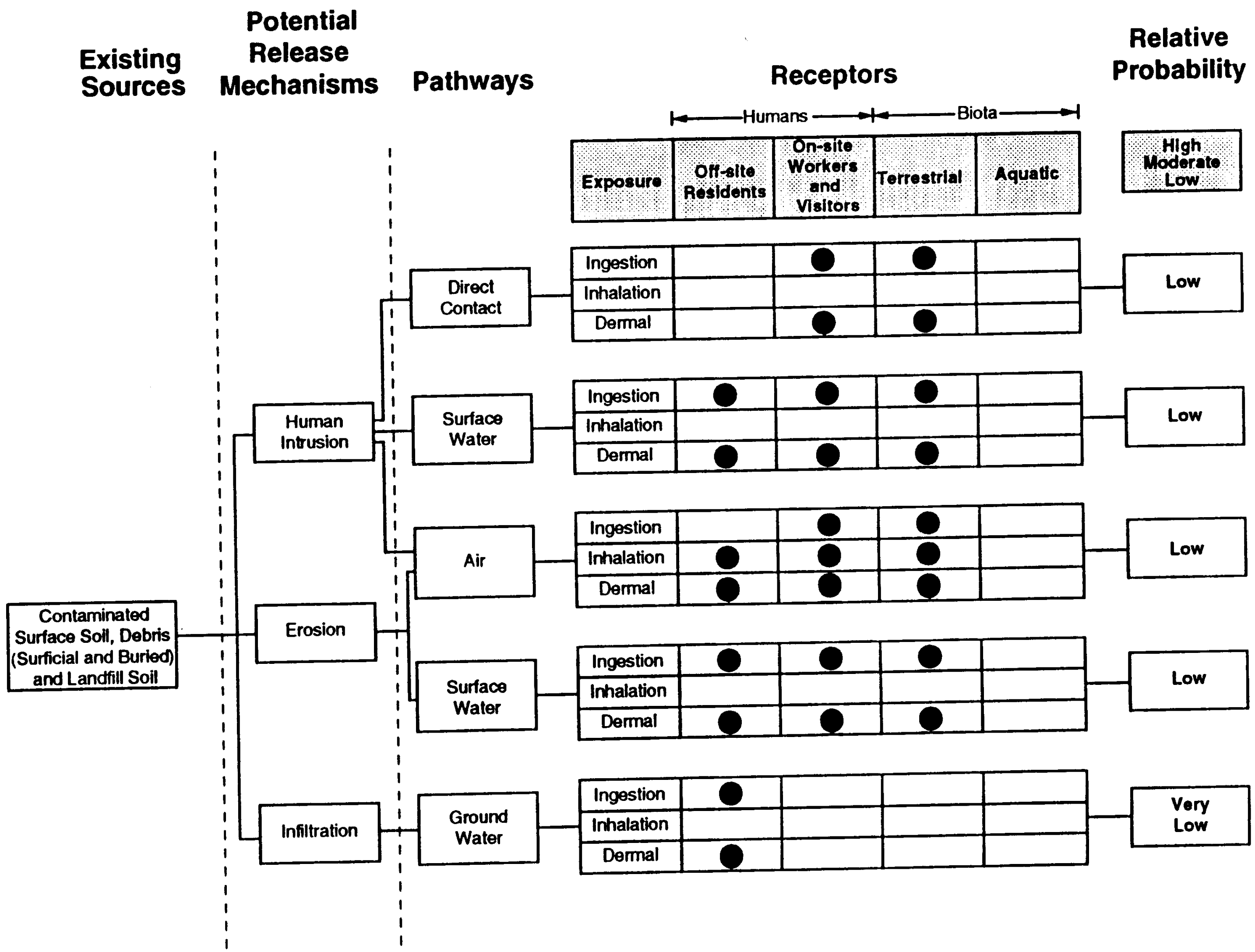


Figure 4.2-3 Surface soil contamination. The relative hazards are judgmentally based on available in formation and assume maintenance of institutional control.

Infiltration: In general, transport of contaminants through the unsaturated zone to groundwater probably is not a pathway of immediate concern at TA-15, based on the great depth to the main aquifer and extensive past Laboratory site characterization efforts that indicate the lack of credible groundwater pathways (Appendix Q of the 1991 IWP).

Human intrusion: Accidental or deliberate human intrusion into surface and subsurface units represents an exposure scenario of low near-term probability. Intrusive scenarios have increased significance over very long time frames, when the potential hazard of the buried waste remains but institutional control cannot necessarily be ensured. Assessment of this scenario for buried radioactive waste is an issue that is being considered by DOE on a national basis (Hora et al. 1991, 0642).

Food chain: The food chain pathway is considered to be a credible but very minor pathway for the OU 1086 because large mammals can move on and off-site. Since institutional control is assumed for approximately 100 yr, legal hunting will not occur for at least 100 yr.

Receptors: The maximally exposed human receptors are on-site employees and visitors. Other receptors are unlikely to be important while institutional control is maintained.

4.2.4 Conceptual Model Refinement

Additional site characterization data will enable further refinement of the conceptual model by providing data that test hypotheses in the current model. Data obtained during the TA-15 RFI as well as new results from other operable units, the ER Framework Studies Program, and the Laboratory's Environmental Surveillance Program will be integrated into updated models.

Proper refinement of the site conceptual model is an integral part of building an accurate picture of the site processes and pathways important to contaminant migration. As appropriate, mathematical models will be derived from the conceptual model to guide later data collection, hypothesis testing, risk assessments, and design of the CMS.

4.2.5 Summary of General Data Needs

Table 4.2-2 summarizes the overall data needs for the OU 1086 as generated from discussions of available information earlier in Chapters 3 and 4. Although this list may appear to be long, not all of these data are needed for each OU 1086 SWMU, and the level of detail required is not necessarily great. In addition, much of this information will be collected jointly with other operable units (or Frameworks). The field sampling plans in Chapters 7 through 10 explicitly describe the plan by which the required data will be obtained from TA-15.

4.3 Health-Based Preliminary Characterization Goals

This Section is divided into two parts. Subsections 4.3-1 — 4.3-3 discuss the inactive firing site E-F; Subsection 4.3.4 discusses the active firing site PHERMEX.

The first part, a health-based assessment using the codes RESRAD, DECOM, and DECHEM, was carried out to obtain preliminary characterization goals similar to screening action levels for radioactive contaminants.Screening action levels are unavailable for radioactive contaminants. The area studied, E-F site has been the site of greatest remediation concern. It is now an inactive site but was used over a long time period for large experiments. The assessment used the land use scenarios described in Subsection 4.2.1: institutional use as firing sites, recreational use, and laboratory use. These levels of contaminants in the soil are shown in Table 4.3.1

The second part consists of risk assessment calculations for occupational workers at the most heavily used current active site, PHERMEX (Subsection 4.3.4). This assessment yields estimates of safe levels of surface contaminants that are allowable under current government regulations.

4.3.1 Preliminary Assessment for Inactive E-F Site, TA-15

The following preliminary assessment is based on data for E-F site obtained from studies conducted during the late 1970s (see Chapter 7 for detailed data and references). Much of this work was aimed at an early assessment of effects of the residual depleted uranium (DU) resident in the environment from explosive tests that had dispersed the material around the area of E-F site (depleted uranium is uranium from which uranium-235 has been separated out). The explosive dispersal resulted in a radial deposition with concentrations decreasing as the sampling moved away from the center of the site Some localized hot spots were encountered as well as surface movement along drainage paths off the site.

The studies covered a circle with a radius of 200 m; thus, the area examined was 126 000 sq m. Outside the circle, the activity levels for uranium approached the background soil level of 10 µg/g of soil. The levels of DU detected ranged from less than 10 µg/g, to 8600 µg/g, exclusive of visible metal fragments at one hot spot in the center. To estimate doses from the site, researchers used more typical numbers over the larger area; these data were taken from the work of Hanson and Miera (1977, 0128) and White et al (1980, 0771). The mean value for the largest part of the area was 675 µg/g with the isopleths ranging from 30 to 1000 and constituting 92.7% of the area. Small areas with high DU concentration of a size that might accommodate a garden or campsite for recreation were averaging about 4500 µg/g but made up less than 10% of the area. The depth of the soil samples was 0 to 30 cm. The amount of DU decreased rapidly with depth except at the disturbed center part of the site. With that exception, the majority of DU was located in the top centimeter of the soil at the site.

The actual composition of DU varies with the level of uranium-235 extracted at uranium enrichment plants. So DU weights were used to obtain activity from the specific activity of the uranium isotopes. For the purposes of this calculation an average of the remaining U-235 of 0.2% was used although some natural uranium was also used on Firing Site E-F.

The dose limit selected for exposure to the depleted uranium is based on two DOE orders. First, DOE Order 5400.5 limits the exposure of on-site personnel who are not assigned to the area of interest to 25 mrem/yr from all pathways. In addition, an as low as reasonably achievable (ALARA) determination must be made. In addition the US Environmental Protection Agency (EPA) has provided guidance on the exposure from a Superfund site. The limit provided was 25 mrem/yr from all pathways. The overall limit must satisfy the dose limits for the groundwater pathway at 4 mrem/yr and the airborne pathways at 10 mrem/yr. The appropriate pathway analysis would allow apportionment of the 25 mrem/yr into limits for each pathway, depending on the pathways present.

For the calculations, parameters for the source of contamination by DU are listed in Table 4.3-1.

TABLE 4.3-1
SUMMARY OF ESTIMATION OF RADIOLOGICAL CONTAMINATION LEVELS AT E-F SITE

	Mean Case		Maximum Case	
Soil concentration of DU	675	µg/g	4500	µg/g
Depth of contaminant	.05	m	.05	m
Size of contaminated area	125 000 m^2		9100	m^2
Isotopic mix	^{238}U	99.8%	^{238}U	99.8%
	^{235}U	0.2%	^{235}U	0.2%
	^{234}U	0.0015%	^{234}U	0.0015%
Activity per gram of soil	^{238}U	223 pCi/g	^{238}U	1455 pCi/g
	^{235}U	3 pCi/g	^{235}U	20 pCi/g
	^{235}U	64 pCi/g	^{234}U	425 pCi/g
Age of Contaminants	30 yr		30 yr	

4.3.2 Description of Models

4.3.2.1 Radiological Dose

DOE Order 5400.5 has approved the use of a standardized computer code developed by Argonne National Laboratory (ANL) (Gilbert et al. 1989, 0754) to calculate dose in units of committed effective dose equivalents (CEDEs) to maximally exposed population group. The code, Residual Radioactive Material (RESRAD), applies site-specific parameters for each effective pathway in a chosen exposure scenario. For OU 1086 (E-F site), the choice of the residential scenario, although not a realistic scenario, is calculated as a reference and leads to activation or deactivation of pathways discussed above. The RESRAD code requires some site-specific input parameters if relative importance of exposure pathways for the residential scenario is to be assessed. OU 1086 input parameters are presented in Table 4.3-2. Many parameters (e.g., inhalation, dietary and nondietary pathways, and soil ingestion) are default values recommended by the EPA (EPA 1989, 0304; EPA 1991, 0746; Clement Associates 1988, 0745). These default values are considered conservative estimates. Site-specific climatic values such as precipitation, irrigation, run-off coefficient, wind speed, and erosion rate are used. Hydrologic parameters for the OU's three geological strata–the contaminated, saturated, and unsaturated zones–are also site specific. The groundwater pathway is not assumed to be a viable route of exposure. Climatic and hydrologic parameters peripherally affect other pathways, such as the uptake of radioactive contaminants by root systems.

The possible land use scenarios that were developed for RESRAD were those of a recreational user and a worker in a facility built on top of the contaminated area. The default value of RESRAD is 200 $\mu g/m^3$, which represents a very windy condition that the New Mexico Environmental Department's measurements indicate has not occurred in Los Alamos County. The second value of 100 $\mu g/m^3$ still exceeds the mean value for Los Alamos but does represent a more realistic scenario. The recreational use assumed an individual who lived 1 month at the site. The worker was in the facility for 50 wk per yr with an average work week of 45 hr. The results of these calculations are summarized in Table 4.3-3.

For the smaller area of higher contamination (4500 µg/g DU) [Table 4.3-3(a)], the estimated recreational user dose is 9 mrem/yr and an estimated worker dose of 29 mrem/yr. The dose rates also exceed the DOE Order 5400.5 and EPA Office of Radiation Programs Guidance that sets a limit of 25 mrem/yr from all pathways for a member of the public, which in the case of TA-15 are on-site workers. However, many of the assumptions in this calculated assessment are extremely conservative.

The larger area has been estimated to contain an average of 675 µg/g of soils [Table 4.3-3(b)], which results in dose rates for the recreational user of 1 mrem/yr for the worker in a facility built on this area of 5 mrem/yr, respectively. Recreational and occupational use of a large portion of Firing Site E-F appears to be feasible without further remediation work.

RESRAD allows calculation of dose rates out to 10 000 years. Drinking water is not a plausible pathway of contamination for the site. Calculations with RESRAD indicate that even low adsorption of radioactive materials on their way to the water table results in an insignificant small estimated dose in 10 000 yr.

To check the above calculations, two other models were used to see if the dominant doses would still originate from the same pathways. The first model was that of DECOM by Radiological Assessments Corporation. The model, written by Oak Ridge National Laboratory (ORNL), can be used the same as RESRAD either (1) to state a dose limit and calculate corresponding soil concentrations or (2) to state radionuclide concentration profiles in soil and to

TABLE 4.3.2

MESA-TOP PRELIMINARY DOSE ESTIMATION AT E-F SITE

Parameter Description Pathway Conversion Factors	Parameter Value Adult, Child (if different)	Source
Inhalation rate	7297 m^3/yr, 5869 m^3/yr	EPA 1991, 0746
Mass loading for inhalation	0.0002 g/m^3	NMEID 1990, 00704
Dilution length for airborne dust inhalation	3.0 m	Gilbert et al. 1989, 0754
Occupancy factor, inhalation	0.45	Calculated
Occupancy and shielding factor external gamma, based on exposure frequency	0.60	Calculated
Fruit, vegetable, and grain consumption	124 kg/yr, 62.4 kg/yr	EPA 1991, 0746
Leafy vegetable consumption	36 kg/yr, 29 kg/yr	Clement Assoc. 1988, 0745
Soil ingestion rate	36.5 g/yr, 73 kg/yr	EPA 1991, 0746
Mass loading for foliar deposition	0.0001 g/m^3	Gilbert et al. 1989, 0754
Depth of soil mixing layer	0.15m	Clement Assoc. 1986, 0745
Depth of roots	0.9m	Site data
Exposure Frequency		
Fraction of time spent indoors	0.50	Calculated
Fraction of time spent outdoors, on site	0.25	Calculated
Contaminated Site Assumptions		
Area of contaminated zone	See Table 4.3-1	Site data (Hansen & Miera 1977, 0128)
Thickness of contaminated zone	0.05 m	Site Data (Hansen & Miera 1977, 0128)
Length of flow parallel to aquifer	2.5 m	Calculated
Time since placement of material	30 yr	Site data (Hansen & Miera 1977, 0128)
Cover depth (assume contaminants on the surface)	0.0 m	
Climatic Parameters		
Evapotranspiration	0.6	*
Precipitation	0.4 m/yr	*
Irrigation	8.0 m/yr	Site data (LANL/ES/160,1989)
Irrigation mode	overhead	Site data (LANL/ES/160,1989)
Run-off coefficient	0.52	Site data (LANL/ES/160,1989)
Irrigation fraction from groundwater	0	Site data (LANL/ES/160,1989)

TABLE 4.3-2 (*Cont.*)

MESA-TOP PRELIMINARY DOSE ESTIMATION AT E-F SITE

Parameter Description Pathway Conversion Factors	Parameter Value Adult, Child (if different)	Source
Geologic Strata		
Contaminated Zone		
Soil density	1.6 g/cm^3	*
Erosion rate	0.001 m/yr	*
Total porosity	0.4	*
Effective porosity	0.2	*
Hydraulic conductivity	50.0 m/yr	*
Soil-specific b parameter	5.3	Gilbert et al. 1989, 0754
Saturated Zone		
Soil density	1.6 g/cm^3	*
Total porosity	0.3	*
Effective porosity	0.3	*
Soil-specific b parameter	5.3	Gilbert et al. 1989, 0754
Water table drop rate	0.3 m/yr	*
Model: (nondispersion or mass balance	Nondispersion	Gilbert et al. 1989, 0754
Unsaturated Zone 1		
Thickness	260 m	DOE 1979, 0051
Soil density	1.6 g/cm^3	DOE 1979, 0051
Total porosity	0.5	DOE 1979, 0051
Effective porosity	0.4	DOE 1979, 0051
Hydraulic conductivity	30.0 m/yr	DOE 1979, 0051
Soil-specific b parameter	5.3	Gilbert et al. 1989, 0754
Unsaturated Zone 2		
Thickness	100 m	DOE 1979, 0051
Soil density	1.6 g/cm^3	DOE 1979, 0051
Total porosity	0.4	DOE 1979, 0051
Effective porosity	0.2	DOE 1979, 0051
Hydraulic conductivity	37.0 m/yr	DOE 1979, 0051
Soil-specific b parameter	5.3	Gilbert et al. 1989, 0754

*Values from Purtymun and Stoker (1988m, 0205) and Abeele et al. (1981, 0009).

TABLE 4.3-3 (a)

TA-15, E-F SITE DEPLETED URANIUM IN SOIL RESRAD ESTIMATED DOSES FOR SCENARIOS OF EXPOSURE 9100m^2 CONTAMINATED WITH 4500 µg/g (AVERAGE)

Scenario	Dose mrem/yr	Dominant Pathway	Elapsed Time for Maximum (yr)	Comments
Recreational use	9	External radiation	0	One Month or 4 wk, 24 h/day
Worker in building	29	External radiation	0	50 wk 45 h/wk

TABLE 4.3-3 (b)

TA-15, E-F SITE DEPLETED URANIUM IN SOIL RESRAD ESTIMATED DOSES FOR SCENARIOS OF EXPOSURE 125 000m^2 CONTAMINATED WITH 675 µg/g (AVERAGE)

Scenario	Dose mrem/yr	Dominant Pathway	Elapsed Time for Maximum (yr)	Comments
Recreational use	1.4	External radiation	0	One Month or 4 wk, 24 h/day
Worker in building	29	External radiation	0	50 wk 45 h/wk

calculate doses. However, the two approaches are similar enough for one to compare origins of the dominant doses. The results of the DECOM calculations indicate that external dose is dominant, followed by dust inhalation. In both models, ingested soil and food grown on the site are a fraction of a percentage of the total dose. Estimates of the predominant sources of dose rates are also in agreement for calculations out to 10 000 yr.

4.3.3 Estimation of Preliminary Characterization Goals for Uranium on OU 1086 Based on Future Land Uses.

RESRAD also calculated a site-specific soil contamination preliminary characterization goal. Based on a 10 mrem/yr limit from all pathways to a permanent resident, the soil concentration of DU that could be left in place is estimated to be 140 pCi/g of soil (approximately 400 µg/g DU). This estimate is based on an annual average 200 µg/m^3 dust loading in air that is more likely to average less than 100 µg/m^3. For example, the New Mexico Environmental Department reported the highest seasonal average measurement in the fall quarter of 1987 as 40 µg/m^3 of particulates in air.

4.3.4 Estimation of Safe Levels of Hazardous Materials for Occupational Workers at PHERMEX

A risk assessment for occupational workers at PHERMEX has been done and details are given in Appendix F. A resuspension rate model and the CAP-88 computer program were used. This risk assessment was carried out to determine what concentration levels of contaminants in the soil meet worker safety standards for present-day occupational usage of active firing sites, especially PHERMEX.

The PHERMEX facility at TA-15 is engaged in the explosive test involving various materials including DU. A small percentage of tested material is aerosolized into small particulates, which are irretrievable. Table 4.3-4 lists the accepted fraction of elements aerosolized during firing site experiments (Environmental Protection Group 1992, 0740).

TABLE 4.3-4
ESTIMATED CONCENTRATIONS OF TOXIC ELEMENTS AEROSOLIZED BY FIRING SITE EXPERIMENTS IN 1990

Element	1990 Total Usage (kg)	Fraction Aerosolized (%)	Annual Average Concentration(µg/m3) (4 km)[a]	(8 km)[a]
Uranium	87	10	8.4×10^{-6}	3.4×10^{-6}
Beryllium	0	2	0	0
Lead	2	100[b]	2.1×10^{-6}	8.5×10^{-10}
Heavy metals	234	100[b]	2.5×10^{-4}	9.8×10^{-5}

[a]Distance downwind.

[b]No data are available; estimate was done assuming worst-case percentage was aerosolized.

Particulates may become airborne through wind resuspension processes and, subsequently be inhaled by site personnel. In addition, gamma-emitting radionuclides formed by the radioactive decay of uranium (protactinium-234, Pa-234m, and thorium-231) provide external exposure to site workers whether airborne or not. Consequently, DU particulates pose a potential radiological hazard to TA-15 site personnel. Other potentially harmful nonradiological metals of concern used in TA-15 explosive testing include lead, mercury, and beryllium.

The risk assessment shown in Appendix F calculates the safe level of surface contamination, principally DU, that can exist in surface soils for occupational workers. Safe levels are based on allowable regulatory exposure levels of surface contaminants. For radionuclides, the most restrictive regulatory exposure level is the 2.0 rem/yr effective dose equivalent standard imposed by the DOE for on-site radiation workers [and as low as reasonably achievable (ALARA)]. For other hazardous metals, the most restrictive exposures are air concentrations for 40-h/wk exposures found in the Threshold Limit Values (American Conference of Governmental Industrial Hygienists 1990, 0858). The most restrictive chemical form of the element is assumed to exist.

The calculation of surface-contamination levels that are acceptable for present-day occupational usage are based on an annual worker schedule that places a hypothetical worker at several representative expected work locations through the course of a year. The exposure scenario uses a worst-case annual work schedule placing workers at locations of maximum exposure for long periods of time. Three specific work locations were identified, each possessing a specific frequency of occupation during a representative work year. In the test-site area, workers are directly exposed to contaminants contained in the surface soils. Exposure by inhalation and external irradiation is possible. A wind resuspension model is used to calculate airborne concentrations of contaminants above the contaminated surface soils. A second approach that utilizes site-specific measurements of the mass-loading of surface soil particulates is used as an independent check of results. The second location of exposure is building R310, adjacent to the test-firing area. Here workers can be exposed to an airborne concentration of contaminants similar to those in the test-fire area. External irradiation, however, is assumed not to occur. Lastly, the same worker routinely occupies building R-183 located 1200 m to the west-northwest of the test-firing area. Exposure here can occur from material that originates in the test-firing area and is dispersed. A resuspension rate model is used to estimate an area source term from the test-fire area. The CAP88 computer code (EPA 1992, 0859) is used to assess the resulting downwind contaminant air concentration. For radionuclides, exposure rates are calculated for each location. An annual dose is calculated based on the time spent at each location. For nonradiological contaminants, the maximum concentration experienced by a worker is calculated.

Calculation results indicate that a surface-contamination level of 4.8 g/m^2 of DU (15 700 mg/kg) would not exceed the 2.0 rem/yr exposure standard for site personnel. Surface soil measurements conducted at TA-15 indicate that 400 mg/kg is indicative of an average level of soil contamination currently found at PHERMEX.

4.3.5 Screening Action Levels for Beryllium

For nonradiological contaminants, acceptable surface soil concentrations were found to be 429 mg/kg , 33 000 mg/kg , and 2200 mg/kg for beryllium, lead, and mercury, respectively (derived in Appendix F). Of these, only beryllium has been measured in surface soils and was found at an average level of 32 mg/kg. As part of the experiments that dispersed DU, beryllium may be present in quantities large enough to be a carcinogenic risk.

Section 3 of the IWP for Los Alamos National Laboratory has assembled preliminary screening action levels for a number of toxic and hazardous materials. Action levels are currently being developed for future IWPs. Appendix F of the IWP 1991 lists the preliminary screening action levels for beryllium. The different screening action levels for different environmental media are listed in Table 4.3-5.

TABLE 4.3-5
SCREENING ACTION LEVELS FOR BERYLLIUM

Media	Risk	Screening Action Level
Soil	Systemic toxicant	1300 mg/kg
Soil	Carcinogen	0.14 mg/kg
Water	Systemic toxicant	180 μg/l
Water	Carcinogen	0.019 μg/l
Air	Carcinogen	0.00097 $\mu g/m^3$

These screening action levels are conservative values to be used with a residential scenario. As previously stated, residential use is not considered to be a viable future land use for TA-15. Remediation goals based on future land uses (institutional or recreational) will be developed in a manner similar to the acceptable surface soil concentrations for occupational workers discussed in Subsection 4.3.4. Screening action levels define the level at which the pollutant must be monitored. With levels below the screening action level, the land may be used even in a residential scenario with confidence.

4.4 Decision Process

All PRSs within the OU 1086 are evaluated by the five-step decision process illustrated in Figure 4.4-1. Each of the five diamonds in the diagram represents a point at which a decision is or will be made for each PRS under consideration. To ensure simplicity in the process, each question has been posed with usually only two possible answers, "yes" or "no." If the answer has some "uncertainty" or is a "maybe," it is classified as a "yes" answer in this process. The process is designed to identify those PRSs that can be recommended for NFA as early in the process as possible and with the least expenditure of resources. Those PRSs that cannot be recommended for NFA after Phase I and Phase II investigations and risk assessment are complete will be candidates for a CMS.

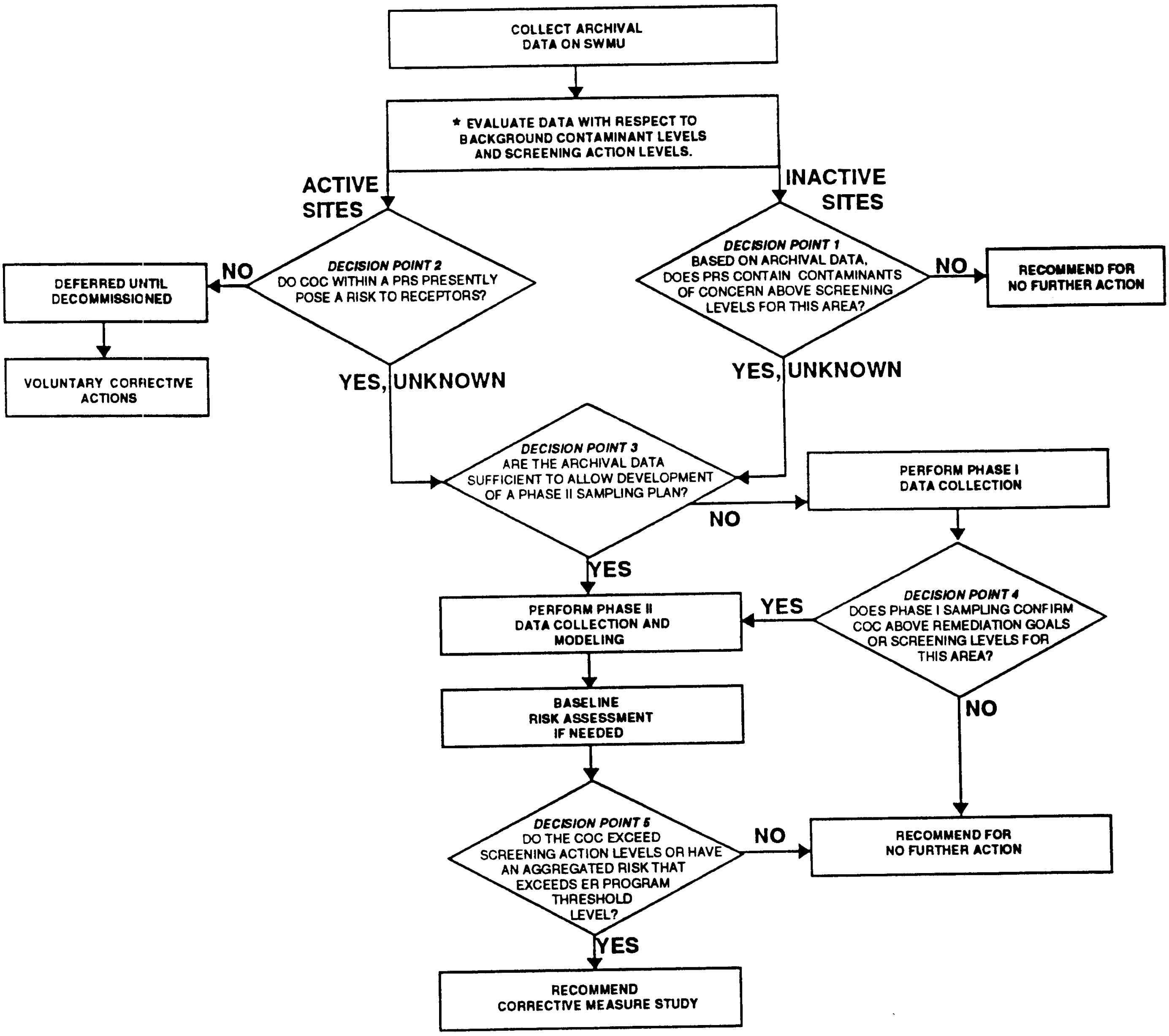


Figure 4.4-1 Flow chart of the technical decision process.
* background contaminant levels will be evaluated in accordance with IWP 1992, 0768 Figure 4-2, page 4-8

A more detailed discussion of the technical approach for the OU 1086 RFI, which amplifies the general process flow illustrated in Figure 4.4-1, appears in the following subsections.

The basic approach of the RFI for OU 1086 is summarized as follows:

- Archival data are gathered to help researchers define a basic understanding of the processes and events that produced each PRS and the contaminants of concern (COCs) that may be present at each PRS.
- A health-based risk assessment, based on archival data, is made for the major contaminants, uranium, and beryllium, for two key units of OU 1086, PHERMEX, (an active site) and E-F site (an inactive site) and is based on present day usage and reasonable projected future end uses of the land and reasonable pathways of transport to the receptors involved in this land use. Remediation goals of the potentially hazardous materials, uranium and beryllium, are formulated from this risk assessment and are calculated because screening action levels for non-residential areas were not available when this RFI was written
- The sites are divided into two categories: active and inactive. There are four sites officially designated active. At these active sites where there is no health risk to occupational workers, in general the level of contamination may change and so characterization will be left until decommissioning (see Chapter 6 for further elaboration). Occupational workers are monitored continuously. Therefore, it is known there is no immediate risk to occupational workers. At the inactive sites, the level of contamination will only change through natural causes (wind, erosion, etc.) and so characterization may be appropriate.
- The archival data are evaluated against the remediation goals, in the same manner as Phase I data, to identify those PRSs for which no potential hazard exists and no further action is required. The number of sites that must undergo field investigation can thus be reduced.
- All PRSs are evaluated in the health-based risk assessment for risk to present-day receptors. Based on this assessment, decisions to defer action until the associated building or site is decommissioned.
- The PRSs that require field investigation at the present time are assessed on the basis of archival information to determine whether the initial characterization effort will be a limited Phase I or a more detailed Phase II investigation.
- Phase I field investigations are carried out as needed to determine the presence or absence of COCs above guidelines and to supplement existing information on known source terms or site conditions.

- Data gathered during Phase I investigations are used to determine which PRSs need further characterization, which need further characterization but may be deferred for action, and which may be recommended for no further action NFA. For PRSs that require further study, Phase I data are used and modeled to help design Phase II sampling and analysis plans (SAPs). The RFI work plan will be amended and submitted to the EPA for review and approval after Phase II SAPs have been completed for sites requiring Phase II investigation. Interim phase reports (formerly referred to as technical memoranda) will be submitted either at the conclusion of a major sampling phase or annually.
- Phase II field investigations are conducted where appropriate to fully characterize the nature and extent of contamination and to obtain the data necessary for a quantitative assessment of risk posed by COCs.
- A final risk assessment is conducted for each PRS once the data needs have been satisfied by the field investigation.

An RFI report is compiled that contains the results of field investigations and recommendations for PRSs that have been evaluated by the decision process. PRSs are recommended for CMS when the analytical results exceed certain values established during risk assessment. The remaining PRS are recommended for NFA. Recommendations of NFA will be supported by criteria that are discussed in the following text and in Chapter 5 of this OU work plan.

4.5 Implementation of Decision Process

4.5.1 Decision Point 1

Based on archival data, does PRS contain COC above screening levels for this area?

Section J of the Laboratory's HSWA permit allows the Laboratory to submit an application for a permit modification when available information demonstrates that releases from PRSs that pose a threat to human health or the environment are not occurring. The function of Decision Point 1 is to differentiate between PRSs that clearly do not pose a potential risk to receptors and those that require further investigation. This decision can be made on the basis of qualitative archival information and requires professional judgment on the part of the decision maker.

A "yes" decision indicates that the PRS under consideration poses some degree of potential risk or that the available data are insufficient to deny the possible existence of risk. All such PRSs are recommended for further consideration at Decision Point 2. A "no" decision indicates that the PRS poses no potential risk and should be recommended for NFA.

Evaluation at Decision Point 1 divides the OU 1086 PRSs into two sets. One set consists of PRSs recommended for NFA and another set consists of PRSs that must be evaluated at Decision Point 2. Because the first decision is based on existing information, all OU 1086 PRSs were evaluated at Decision Point 1 during the preparation of this OU work plan. OU 1086 PRSs recommended for NFA at Decision Point 1 and the criteria used for the basis of such recommendations are addressed in Chapter 5.

4.5.2 Decision Point 2

Do the contaminants of concern within a PRS presently pose risk to receptors?

The risk assessment calculations of Section 4.3 examined the present use of the firing sites at TA-15 to determine if an unacceptable risk to any receptors presently exists. If there is an unacceptable risk, then the answer here is "yes" and the decision process must proceed. If there is not a risk, then further action can be deferred, depending upon the type of site or PRS that is being addressed.

Many of the PRSs on OU 1086 are "active" PRSs that are either firing sites used by the Laboratory operating group on a continuing basis or are utilities—either in use or in the process of being deactivated—connected to buildings that are in use by the operating group. Therefore, any further action on these PRSs will be deferred until the active site, building, or utility is decommissioned. At that time the RFI process will proceed with a sampling plan or a voluntary corrective action (VCA). If during the active use of the site, building, or utility, evidence becomes available that this PRS is now of potential risk to receptors, action can no longer be delayed and the technical process for this SWMU would revert back to Decision Point 2 (see Figure 4.4-1).

4.5.3 Deferred until Decommissioned

The RCRA regulations were formulated to address existing and future hazardous waste-handling processes, such as generation, transportation, storage, and disposal. On- and off-site releases of hazardous waste or waste constituents from PRSs on permitted facilities, such as the Laboratory, must be investigated and, if necessary, corrected.

If available information of the hazardous materials located on a PRS shows that the amount of hazardous material is above the remediation goals, based on future land use, but assumed risk assessment shows that waste is not presently a risk to present-day receptors—any site workers—any further characterization or cleanup activity may be deferred until the site of the PRS is decommissioned or else has become hazardous to site workers.

Chapter 6 will use these criteria for making recommendations for deferred until decommissioned (D&D). An example of the decision process to be shown in later chapters is that of an active firing site PHERMEX [SWMU 15-006(a)], which will not have a sampling plan submitted in this RFI work plan. However, SWMU 15-006(h) is an inactive site at PHERMEX which does have a sampling plan (Chapter 8). Enough archival information is available to state that workers on site are not exposed to too large a health-based risk if they work the normal number of hours on the PRS each year as required by the operational activities

(Appendix F). The information on the quantities of hazardous wastes on this site will be updated routinely to assure that future workers will not incur high exposure. Should this occur, however, the decision process would then go forward into Phase II sample collection and subsequent actions.

4.5.4 Decision Point 3

Are the archival data sufficient to allow development of a Phase II sampling plan for this PRS?

Decision Point 3 allows the set of PRSs requiring further characterization to be sorted for development of Phase I or Phase II SAPs. Archival data were reviewed against several criteria to help researchers determine if Phase I or Phase II sampling is more appropriate. These criteria include the following:

- Probability that COCs are present above the cleanup levels that are likely to be set for the TA-15 OU;
- Probability that the lateral and horizontal extent of contamination is known with sufficient accuracy for risk assessment;
- Suitability of existing analytical and site geotechnical data (both location and analytes) for the design of a Phase II SAP; and
- Knowledge of experimental or operational processes that contributed to the PRS wastes.

Many TA-15 PRSs have an archival data set that provides significant insight into the nature and extent of contamination. For some of these PRSs, the Phase I investigation may be minimal and highly focused and may lead to a subsequent recommendation for NFA. However, some archival data are of unsubstantiated quality or are concerned only with radionuclides. In most cases of this type, confirmatory field investigation and analysis is proposed for PRSs going into Decision Point 3.

Decision Point 3 does not provide a mechanism by which PRSs can be recommended for NFA. Instead, NFAs are addressed by the criteria presented in Chapter 5. Decisions made at Decision Point 3 produce two sets of PRSs. Because Decision Point 3 is made on the basis of existing data, this decision has been made for each PRS during work plan preparation.

4.5.5 Phase I Sampling Process

The phased approach to site characterization used in this OU work plan is consistent with EPA and the Laboratory's IWP guidelines. The technical approach generally uses Phase I field investigations to confirm the presence or absence of COCs above the screening action levels that are likely to be set at each SWMU by risk assessment, statute, or other standards.

Phase I sampling will be performed at PRSs for which the potential for significant contamination cannot be ruled out categorically. In these cases, the objective of Phase I sampling is not complete characterization of the site but is simply detection of COCs and their general concentration and location. The

Phase I sampling design process attempts to model the "worst case" condition of the contaminant scenario so that Phase I sampling points can be chosen with the maximum chance of yielding confirmatory results. Researchers will use field survey methods and a field laboratory, as appropriate, to obtain fast-turnaround data and to rapidly evaluate data needs for Decision Point 4 (discussed in Subsection 4.5.6). As analytical results become available, SAPs will be revised as necessary to focus additional data collection. In this manner, an iterative process is established that retains flexibility as new data are obtained. Data acquired in Phase I will serve as input for Decision Point 4.

The quantitative data from Phase I will be used to design Phase II. Accepted statistical concepts for evaluating sufficiency of sampling and additional data needs for modeling waste migration will be identified with the aid of Phase I data.

4.5.6 Statistical Approach to Sampling Plans

This work plan incorporates a statistically based approach to aid in determining sampling needs for Phase I assessment. Statistically based techniques are used to guide sampling designs at PRSs where locations of potentially contaminated sites are uncertain. This uncertainty may arise either because the method of dispersal of potentially hazardous materials is random (such as through debris scatter from firing sites) or where the location of a facility that may have released hazardous materials is now uncertain (such as a potentially contaminated settling tank that was removed decades ago). In both cases, the sampling design was based upon both judgmental and statistical considerations.

The reconnaissance sampling approach described in Appendix H of the IWP (LANL 1992, 0768) was used to guide sampling design. This approach relates the number of samples (N) to the fraction of the site (f) that is contaminated. This relationship is expressed by the equation $P = 1 - (1 - f)^N$. For consistency, and to assure an adequately high level of confidence in the results, a probability P of 95% was used in each case. For this value of P, the relation between f and N is shown in Table 4.5-1.

TABLE 4.5-1
RELATIONSHIP BETWEEN PERCENT OF CONTAMINATED AREA AND THE NUMBER OF SAMPLES NECESSARY TO HAVE A CONFIDENCE LEVEL OF 95%

Percent of Area Contaminated (f)	Number of Samples (N)
5	59
10	29
20	14
30	9
40	6
50	5
60	3
70	2
80	2
90	1
100	1

It can be seen from the foregoing tabulation that the number of samples increases dramatically as the percentage of area thought to be contaminated decreases. Further, the method is independent of the size of the area to be sampled (which is considered large relative to the size of each sample), it does not take into account the potential severity fo the contamination hazard that may be present (unless one of the three parameters, for example, the value of P is adjusted), and it assumes that all sampling results are accurate.

At some sites the value of f could be reasonably estimated based upon archival information, but at other sites such information did not provide a reliable basis for determining f. Because of the lack of a reliable basis at many sites for assuming a value of f, and in view of the aforementioned limitations in the statistical method, the approach was taken to determine a reasonable value to N based upon the size of the site, the expected severity of the contamination hazard, and the expected nature and distribution characteristics of the potential contaminants. In general, the sample sizes were increased for larger size sites and for higher potential contamination hazards. Having determined a value for N, the statistical method was used to determine the corresponding value of f, which was then qualitatively checked for general reasonableness considering the available information on the quantities of potential contaminants, the potential methods of release to the environment, and any possible dispersal processes occurring since release. Both N and f were then adjusted to achieve a reasonable sampling design for the site. For application to OU 1086 sites, the parameter f is defined as the fraction of area above background, rather than the fraction of area above screening action levels as used in the IWP. At most of the PRSs in OU 1086, no contamination is expected to be above screening action levels.

At each site where sampling locations were randomly selected, a square grid was established and a random numbers table was used to select numbered nodal points. Although the grid axes were aligned either in the cardinal compass directions or parallel with the boundaries of the area to be sampled, each grid was translated to a random location in space. To reduce bias in the selected sampling point, the grid size was generally selected to provide at least an order of magnitude more nodal points than sampling points. However, at some smaller sites the nodal points were sufficiently close that they were within the zone of expected spatial correlation with adjacent points. At such sites, conditional sampling rules were applied to help assure the independence of each sample.

4.5.7 Decision Point 4

Do the data collected in Phase I sampling confirm the presence of cumulative COCs above the screening action levels that are likely to be set for PRSs on OU 1086?

Decision Point 4 is designed so that PRSs that have been confirmed at Phase I not to have COCs above screening action levels can be recommended for NFA. For those locations where COCs are confirmed, Phase I data will be used in the development of Phase II SAPs. The presence of COCs at a PRS is considered confirmed to be above guidelines if any sample contains any COC in a concentration that exceeds screening action levels for that constituent.

A "yes" answer at Decision Point 4 indicates that COCs at the PRS have been confirmed to be present and above guideline levels. The PRS must then be evaluated at Decision Point 5 or reevaluated as a risk to present receptors. A "no" answer indicates that the absence of COCs above guidelines at the PRS has been confirmed and that a recommendation of NFA is justified. Decision Point 4 is the second point in the decision process at which a recommendation of NFA can be made for a PRS (refer to Figure 4.4-1).

The data required to make a decision at Decision Point 4 include the concentrations of suspected COCs at selected sample locations at each PRS. The purpose of Phase I sampling is to acquire the analytical and field data needed to make a defensible decision at Decision Point 4. Researchers must obtain information on site history, physical site characteristics, chemical and physical behavior of suspected constituents, and other factors before they determine the appropriate locations and depths at which samples must be collected to support confirmation of the presence or absence of potential COCs. The data quality objectives process needed to address these data is discussed in Section 4.6.

4.5.8 Phase II Sampling and Modeling Process

The purpose of Phase II sampling is to develop a model of the nature and extent of contamination at the PRS. The model must be sufficiently detailed to permit final baseline risk assessment and planning of the CMS (if required). The constitution of Phase II SAPs will vary significantly for individual SWMUs as a function of the amount and type of data available from previous studies, from Phase I and framework studies, and from other considerations. Sources of potential variation in the environmental measurement process will be included in the design of Phase II SAPs.

Phase II will likely be an interactive process in which rapid turnaround data will be used to track the progress of the investigation against the data quality objectives (DQOs) for the phase. The Phase II investigation plan will be amended as data needs are refined by Phase I results and by future program office guidance on risk assessment methods, modeling strategies, long-term institutional control, and other issues important to the TA-15 OU.

As Phase II data become available, comprehensive data analysis and modeling of waste migration potential will be conducted. The initial SAPs will be reviewed against transport modeling results and against the initial site conceptual model or sampling rationale for completeness and suitability and will be revised as appropriate. The data set resulting from Phase II will serve as input to subsequent risk assessment.

4.5.9 Risk Assessment Process

Because health-based risk assessments are integral to the Laboratory's RCRA process, baseline risk assessment will be performed for all TA-15 PRSs that undergo Phase II investigation. This assessment will incorporate the total data set for each PRS, as obtained through archival review and Phase I and/or Phase II investigations. The risk assessment methodology will reflect the guidance to be published by the ER Program Office in Appendix K of the IWP. Data quality objectives for Phase II investigations will incorporate any requirements specific to data gathering for risk assessment not otherwise noted, as they become available from the Laboratory's ER Program Office. The risk assessment results will serve as input to Decision Point 5.

4.5.10 Decision Point 5

Do contaminants of concern at this SWMU exceed screening action levels or have an aggregate risk above the ER Program threshold value?

Decision Point 5 is the final step in the decision process and is the point at which PRSs that have undergone field investigation will be recommended for one of the following: CMS, VCA, NFA. The purpose of Decision Point 5 is to allow an evaluation of the total set of validated data now available for each PRS. Concentrations of COCs at each PRS will be compared against the guidelines for each COC present, and the calculated aggregate risk from COCs at the PRS will be compared against the acceptable aggregate risk values as determined by the Laboratory's ER Program Office. It is assumed here that risk assessment methodologies to be adopted by the Laboratory will reflect the basic concepts of proposed Subpart S to 40 CFR 264. A recommendation of NFA at this point in the decision process will be justified for a PRS if each of the following criteria are met:

- The mean sample concentration for any listed COC does not exceed the risk-based action level for that COC; and
- The aggregate risk value for the health-risk-quantified COCs present does not exceed the acceptable risk value set forth by the Laboratory's ER Program Office.

Uncertainty will be handled in accordance with methods shown in Appendix H of the IWP and applicable EPA documents.

4.5.11 Voluntary Corrective Action

Voluntary corrective action/interim action (VCA/IA) may be instituted by DOE or the Laboratory at any time in regard to PRSs upon agreement by EPA.

4.6 Data Quality Objectives Process

There are three stages in the decision process at which data must be collected. The first stage involves the initial collection of pertinent archival information. This information serves as data input for Decision Points 1, 2, and 3. The data required to make a decision at Decision Point 4 are collected during Phase I sampling, the second stage of data collection. Phase II sampling is the third stage of data acquisition. The data needs for Decision Point 5 determine the scope of Phase II efforts.

Because these decisions must be sound we have collected as much reliable archival information about each site as possible. To ensure that data of appropriate and sufficient type, quantity, and quality are collected during Phase I and Phase II sampling, the DQOs process is applied during the development of the Phase I and Phase II SAPs. These SAPs are presented in Chapters 5 through 10 of this OU work plan.

The DQO process is a seven-step process developed by the EPA as a means by which effective and efficient data collection programs can be planned (EPA 1987, 0086). A well-planned data collection program will ensure that the right type, amount, and quality of data are collected on which defensible environmental decisions can be based. The acceptable level of uncertainty also is addressed in the DQO process. The DQO process as applied to all Laboratory operable units is given in Appendix H of the IWP.

The DQO process is a valuable tool for the following reasons:

- It provides a logical, iterative structure for study planning and ensures that the investigation is focused on the critical questions;
- It provides a focused method by which data needs can be determined;
- It helps data users plan for uncertainty; and
- It facilitates communication among the technical team members and minimizes the amount of time and money spent collecting data.

The seven steps in the DQO process, and the locations in this OU work plan where pertinent information is located (other than in the remainder of this section) are as follows:

1. State the problem: The environmental conditions at TA-15 are addressed generically in Chapters 3 and 4 and by specific PRSs in Chapters 5 through 10.
2. Identify decisions that address the problem: Potential land use and remedial actions are developed elsewhere in Chapter 4.
3. Identify inputs affecting the decision: Decision inputs are addressed in Chapters 3 and 4.
4. Specify spatial and temporal domains of the decisions: Domains are addressed in Chapters 3 and 4.
5. Develop logic statements: PRS-specific logic statements (decision questions) pertaining to specific PRS characterization are developed in Chapters 5 through 10.
6. Establish constraints on uncertainty: Uncertainty issues are addressed generically in Chapter 4 and by specific PRSs in Chapters 5 through 10.
7. Optimize design for obtaining data: The characterization plan is addressed in Chapters 7 through 10 for each PRS.

This seven-step process was followed when DQOs were developed for the OU 1086 work plan. Although Decisions Points 1, 2, and 3 require decision maker confidence in archival data, it was decided that decisions made from archival data of uncertain quality could be made without a formal set of DQOs.

Acceptance of archival data at face value sometimes is justified for the purposes of RFI planning. A formal set of DQOs was used in support of Decision Point 3 (post-Phase I) and Decision Point 4 (post-Phase II).

Decision Points 4 and 5 require data of known quality for determination of the nature and extent of contamination and for risk analysis. The OU 1086 RFI work plan follows EPA and IWP guidelines for addressing sampling and analytical uncertainties. In most cases, Phase I data used in making Decision Point 4 will include data of analytical Level III quality. These uncertainty constraints are adopted globally in the RFI process for OU 1086.

As previously stated, risk assessment data needs have not been defined fully for the methods to be used. However, the assumption used in this OU work plan is that methods similar to those in proposed Subpart S to 40 CFR 264 will be applied. It is assumed that guidance on the methodologies and uncertainties associated with those studies will be supplied by the Laboratory's ER Program Office when they are complete. As required, DQOs for the TA-15 OU will be reviewed and amended for consistency as information on risk assessments methodology becomes available.

4.6.1 Phase I Data Quality Objectives

The seven-step process described in Section 4.6 that was used to develop these Phase I SAPs is discussed in following sections and is diagrammed in Figure 4.6-1.

4.6.1.1 Problem Statement

For some OU 1086 PRSs, COCs are suspected, but their presence has not been confirmed and no data are available on the concentrations or specific locations of contaminants. Environmental samples will be collected and analyzed to confirm the presence or absence and the location of COCs at these PRSs. For other OU 1086 PRSs, COCs are known to be present but their full extent and potential for migration are insufficiently known. Environmental data associated with these uncertainties must be collected before risk assessments can be made.

4.6.1.2 Questions to Be Answered

Do Phase I data confirm the presence of COCs above guidelines at this PRS?

If COCs are known to be present at this PRS, do Phase I data provide sufficient information for design of a Phase II investigation?

4.6.1.3 Decision Inputs/Data Needs

Two sets of decision inputs (data needs) that are necessary to support the decisions made at Decision Point 4 have been identified. These sets are

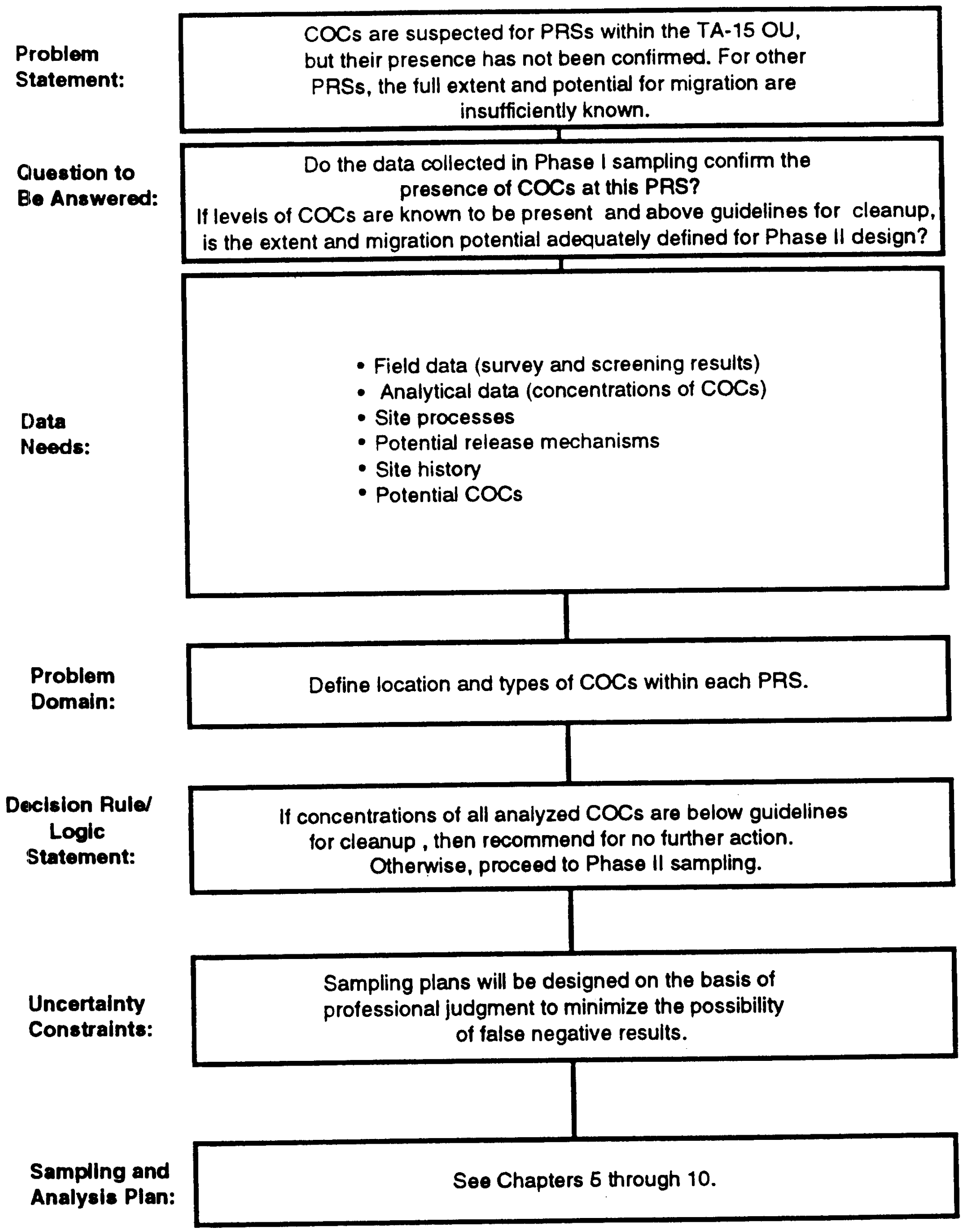


Figure 4.6-1 Data quality objectives process for Phase I of the RFI for the TA-15 OU.

- The information necessary to design an adequate Phase I SAP; and
- The field and analytical data collected during the sampling program.

The first set includes information that must be gathered before the sampling plan is developed. The second set includes the concentrations of COCs as determined by field and laboratory analyses of samples collected at the PRS.

To facilitate the development of the TA-15 work plan, we have assigned the Laboratory's PRSs in the following logical groupings, based on likely characterization response to be recommended to the EPA:

- No Further Action (Chapter 5). These are sites for which sufficient information exists to recommend NFA.
- Deferred until Decommissioned (Chapter 6). There are four active firing sites located on TA-15: R44, R45, Ector, and PHERMEX, of which Ector and PHERMEX are the most heavily used at the present time. In addition to these actively used firing sites, other smaller, nearby related PRSs are considered together with the active firing sites.
- Inactive Firing Site (Chapter 7). Inactive Firing Site E-F is considered alone in this chapter. E-F Site is unique because it has the highest levels of contamination among the inactive firing sites and a great deal of information about it is available. It is the site of greatest concern at TA-15.
- Inactive Firing Sites (Chapter 8). Inactive firing sites are A, B, C, G, and H, which will not be used again.
- Landfills (Chapter 9). Two landfills exist on TA-15: MDA-N and MDA-Z. Sampling plans for MDA-N [SWMU 15-007(a)] and MDA-Z [SWMU 17-007(b)] are presented in this chapter. SWMU 15-008(b) is also considered since it is like a landfill as postshot debris from firing site R44 was deposited here.
- Miscellaneous SWMUs (Chapter 10). PRSs with sampling plans that do not conveniently fit into the above groupings.
- SWMUs Belonging to Other Operable Units (Chapter 11).

For the purpose of setting DQOs, the OU-wide objectives of the OU 1086 RFI are defined as follows:

- Identify contaminants (if any) at each PRS;
- Determine the nature, quantity, and extent of contamination for each PRS; and
- Identify contaminant migration pathways from each PRS and from the OU as a whole.

4.6.1.4 Problem Domain

The problem domain for Phase I sampling includes a definition of the location and types of COCs within each PRS.

4.6.1.5 Decision Rule/Logic Statement

The decision made at Decision Point 4 will be based on the following rule:

> If no single sample collected from a PRS during Phase I exceeds established, health-based guidelines, or the relevant statutory limit (screening action level), then that PRS will be recommended for NFA. If any single sample collected from the PRS during Phase I exceeds those guidelines, then the PRS will undergo further study.

For several reasons, the decision to recommend a PRS for NFA or for further study will not necessarily be based on a statistical characterization of the contamination levels at that PRS. First, any type of averaging of sample results would dilute maximum values and increase the chances of making a Type II error (i.e., a false negative or an incorrect conclusion that COCs are below screening action levels). Second, in most cases the goal of Phase I is not complete characterization but rather simply a determination as to whether COCs are present above cleanup guidelines and the approximate area involved. In addition, for most TA-15 PRSs, the locations of the PRSs are known. Therefore, it is not necessary to resort to geostatistically based schemes to locate areas with maximum probability of contamination.

However, a comparison of sample values with background concentration ranges and cleanup levels could be statistically based, depending upon characterization methods employed by the technical team for background studies. As appropriate, methodology for these comparisons will be added to the OU 1086 work plan revision as it becomes available.

4.6.1.6 Uncertainty Constraints

To fully validate and define a decision to recommend a PRS for NFA at Decision Point 4, we have designed Phase I SAPs so that the probability of a significant false negative result (Type II error) is very low. We did this by focusing the sampling toward those areas judged most likely to contain the highest concentrations of COCs and by including some low-cost redundancy in the field investigation (e.g., area radiological screening). The most serious consequence of a Type II error is that a recommendation for NFA may be made inappropriately.

No attempt has been made in Phase I to limit the chances of false positive (Type I) errors, as these errors will be identified during Phase II sampling. Thus, the main consequence of Type I errors would be the expenditure of additional cost and time in Phase II.

4.6.2 Phase II Data Quality Objectives

Data quality objectives for Phase II SAPs were developed by the seven-step process described in Section 4.6. Data quality objectives for the Phase II SAPs are discussed in the following paragraphs and diagrammed in Figure 4.6-2.

4.6.2.1 Problem Statement

Even if a PRS has been confirmed, either by archival information or data collected during Phase I sampling, to have significant levels of COCs, an adequate picture of the nature and three-dimensional extent of contamination and potential transport processes still may not be known. Environmental data must be collected and analyzed to confirm and clarify these issues so that the health-based risk posed by the COCs can be assessed. Transport and exposure modeling for future use scenarios must be employed to assess the risk.

4.6.2.2 Questions to Be Answered

Do COCs at this PRS exceed screening action levels or have an aggregate risk above the ER Program threshold value? Is there potential for waste migration?

4.6.2.3 Decision Inputs/Data Needs

The purpose of Phase II sampling is to obtain the data needed to support the decision made at Decision Point 5. In general, enough must be known about the nature and extent of contamination at the site and potential transport processes to permit an accurate, health-based risk assessment. If this end is to be met, several sets of decision inputs must be defined during Phase II sampling. These sets include the following:

- The nature and three-dimensional distribution of the contamination;
- The concentrations of COCs at various locations and depths; and
- Information related to the potential for waste migration over time.

To develop a SAP that will provide these data, investigators must consider all information obtained to date, including archival information and data collected during Phase I and other investigations. Consideration of these questions will help to determine the locations and depths at which samples should be collected and the types of analyses that should be run on each sample.

Phase II sampling efforts will be designed on the basis of Phase I or other data. Phase II sampling may use a random, stratified random, or three-dimensional random sampling approach, as appropriate. Data needs for statistical sampling sufficiency include number of samples, sample mean, and sample variability, as described in Chapter 9 of SW 846 and other EPA guidance documents for

Problem Statement:
For those PRSs where COCs are present, the nature and extent of the contamination and importance of potential transport processes must be clarified.

Questions to Be Answered:
Do COCs exceed guidelines for cleanup or have an aggregate risk above the ER Program threshold value? Is there potential for waste migration?

Data Needs:

Nature and Extent of Contamination

- Types of COCs present
- Concentrations of COCs
- Physical and chemical characteristics of COCs
- Vertical and lateral extent of COCs
- Plume dimensions

Typical Media Characteristics

- Soil and/or rock type
- Porosity and permeability
- Physical and chemical properties of soil (e.g., ion exchange, adsorption qualities, moisture content, grain size distribution)
- Heterogeneity in media
- Wind velocity and direction

Problem Domain:
The problem domain encompasses potential receptors, spatial boundaries, and temporal constraints. Potential receptors include site workers and visitors at present and recreational users in the future. Spatial boundaries of the PRS are defined by the limits of migration of COCs. Temporal constraints are a function of constituent-specific chemical and physical properties.

Decision Rule/ Logic Statement:
If no individual COC exceeds its guidelines for cleanup, and the aggregate risk value for all COCs present does not exceed the ER Program risk-threshold value, then recommend this PRS for NFA. Otherwise, recommended for CMS.

Uncertainty Constraints:
Phase II sampling is designed to produce a 95% (one-tailed) confidence rule in COC concentrations.

Sampling and Analysis Plan:
Will depend on results of Phase I.

Figure 4.6-2 Data quality objectives process for Phase II of the RFI for the TA-15 OU.

statistical analysis. Data needs for transport and exposure modeling and for risk assessment will depend on which codes and methodologies are adopted by the Laboratory's ER Program Office for these purposes. The OU 1086 work plan will be amended as required to reflect guidance as it becomes available. As appropriate in developing Phase II SAPs, PRSs recommended for Phase II investigation will be grouped into aggregates on the basis of proximity and similarity of sampling techniques and on requirements to maximize the cost-effectiveness of Phase II investigations.

4.6.2.4 Problem Domain

The problem domain includes analyses based on present and future land uses and potential receptors spatial boundaries (the area of a release and spatial limits of contaminant migration), and temporal constraints (the current chemical/physical form of contaminants and future migration potential). Under present use, potential receptors are identified as Laboratory site employees and visitors. Recreational use by Bandelier National Monument is assumed for OU 1086 after 100 yr of Laboratory institutional control.

4.6.2.5 Decision Rule/Logic Statement

If no individual COC exceeds its guideline and if the aggregate risk value for all risk-based COCs does not exceed the ER Program risk-threshold value, the PRS will be recommended for NFA. Otherwise, the PRS will be recommended for CMS.

4.6.2.6 Uncertainty Constraints

Sample mean concentration estimates with a 95% confidence interval will be used for comparison with action levels and for risk assessment. These constraints parallel those discussed in EPA SW-846 and other EPA publications for statistical analysis of solid waste sites.

4.7 Field and Analytical Data Quality Requirements

Data quality requirements for field and analytical data collected at the TA-15 OU are governed by the need to make defensible, risk-based decisions for each PRS. The information collected will be based on sound professional judgment, required EPA protocol, statistical requirements, and overall data objectives for the project. This section contains a discussion of data quality requirements concerning analytical levels, analytical methods, PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters, and field data quality requirements.

4.7.1 Analytical Data Quality Levels

The following five descriptors are used to define analytical data quality levels (EPA 1987, 0086):

- **Level I:** Data from survey methods used to identify contaminants *in situ*, or field screening methods to be used at the point of sample collection;
- **Level II/III:** Field laboratory or field survey methods used to provide rapid quantitative discrete sample analyses or area surveys during field operations;
- **Level III/IV:** Field or off-site analytical laboratory methods used to provide accurate, precise, and defensible data; and
- **Level V:** Nonconventional methods.

Additional characteristics of the five categories are given in Table 4.7-1. In general, Levels I and II are associated with on-site portable field instruments or tests that can yield real-time survey or screening data. With proper procedures and *in situ* calibrations, on-site surveys and screening can provide defensible data. Levels III and IV are associated with strict field or off-site laboratory protocol and documentation that will generate high-quality, defensible data. Level V will accommodate all special analytical methods that are not covered under standard Level III or IV methods. Quality of Level V work can meet either Level III or IV standards.

4.7.1.1 Phase I Analytical Levels

Investigations for the TA-15 RFI will be performed under a combination of analytical data quality levels to meet the PRS-specific, contaminant-related field investigation requirements described in Chapters 7 through 10.

Phase I investigations generally will be performed under analytical Levels I, II, and III. Levels I and II data will be collected as part of a field survey and screening program that will permit qualitative, real-time evaluations of site conditions. Level I field screening and survey will include a variety of portable field instrumentation or field test kits that continually or periodically can provide information on site conditions. Level I observations also are used as a critical part of the site health and safety plan and for evaluation of samples for determination of proper shipping procedures. Table 4.7-2 provides additional details concerning the instrumentation and methods used at each analytical level.

Level II activities will include the use of field survey methods and portable field laboratories. Field surveys will use surface or borehole geophysics to assist in remote sensing activities or to locate sample points. Mobile analytical laboratories can provide quantitative rapid-turnaround information of Levels I, II, and III quality that can be used to support field strategy decisions.

Mobile field laboratories or off-site laboratories will be used during Phase I to obtain Level III analytical data that can support RFI/CMS decisions for each

TABLE 4.7-1

INSTRUMENTATION AND METHODS THAT MAY BE USED
FOR PROPOSED ANALYTICAL LEVELS

LEVEL I: FIELD SCREENING

- Portable Instruments
  - Field instrument for detection of low-energy radiation
  - Geiger-Müller counter
  - Micro-R meter
  - Organic vapor analyzer (OVA)
  - Photoionization detector (PID)
  - Explosimeter

- Field Test Methods/Kits
  - OVA headspace test
  - HNU headspace test
  - Handby kit
  - Draeger tubes
  - Hazcat kits
  - Lab in a Bag®
  - Hack Kits™
  - High-explosives (HEs) detector
  - Polychlorinated biphenyls (PCBs) detector

LEVEL II: FIELD SURVEYS/INSTRUMENTATION

- Mobile analytical laboratory
- Surface geophysics
- Borehole geophysics
- Soil vapor surveys (portable instruments)
- Radiological screening laboratory
- Airborne and vehicle-based gamma spectrometry system
- Portable X-ray fluorescence
- Field gas chromatography
- Laser-induced fluorescence
- Laser-induced breakdown spectroscopy

LEVEL III/IV: LABORATORY METHODS/INSTRUMENTATION

- SW846 protocol for soil, air, and water analysis for volatile and semivolatile organic compounds and metals which will be used at field laboratories

- Laboratory, DOE, US Army, or EPA analytical methods for radionuclides, high explosives, or miscellaneous analyses [see LANL-ER-QAPjP (Quality Assurance Project Plan)]

- Instrumentation typically includes gas chromatography (GC), gas chromatography/mass spectrometry (GC/MS), inductively coupled plasma/mass spectroscopy (ICP), atomic absorption (AA)

LEVEL V: LABORATORY METHODS

- American Society For Testing and Materials protocol for soil/rock testing
- Method-specific protocol

TABLE 4.7-2

SUMMARY OF ANALYTICAL LEVELS APPROPRIATE TO DATA USES

Data Uses	Analytical Level	Type of Analysis (Example)	Limitations	Data Quality
Site characterization; monitoring during implementation; identification of gross contamination	Level I	Radiological field screening and surveys	Response dependent on radiation type and conditions; response limited to upper 1–2 m of soil	Method-specific
Identification of gross contamination	Level I	HEs spot tests	Matrix dependent	Qualitative
Site characterization; evaluation of alterna-tives; engineering design; monitoring during implementation	Level II	Organics by GC - inorganics by AA X-RF and ICP laser induced fluorescence, laser incuced breakdown spectroscopy	Tentative identification; analyte-specific	Dependent on QA/QC steps employed
		Radiologic field screening and surveys	Response dependent on radiation type	Qualitative or quantitative depending on method
		Field laboratory analyses for some radiological constituents	Tentative identification and quantification	Dependent on QA/QC steps employed
Risk assessment; site characteriza-tion; evaluation of alternatives; engineering design; monitoring during implementation	Level III	Organics/inorganics, using EPA procedures other than Contract Laboratory Program analyte-specific	Specific identification; tentative identification in some cases	Detection limits similar to CLP
		RCRA characteristic tests	Can provide data of same quality as Level IV	Less rigorous QA/QC than that for Level IV
		Radiological constituent	Specific identification; detection limits below background; with suitable QC, gives quality comparable to SW846 protocol	QA/QC comparable to SW846 protocol
Risk assessment; evaluation of alternatives; engineerng idesign	Level IV	Target compound list (TCL) target analyte list (TAL) organics/inorganics by GC/MS, AA, ICP, etc.	Tentative identification of non-TCL parameters	Goal is data of known quality
		Low ppb detection limit	May require time to validate packages	Rigorous QA/QC
Risk assessment	Level V	Nonconventional methods	May require method development	Method-specific
			Mechanism to obtain services requires lead time	Method-specific detection limits

SWMU. In general, data of at least Level II quality must be obtained to support a recommendation of NFA. Strict level quality assurance/quality control (Quality Assurance Project Plan, QAPjP) and sample documentation procedures will be followed (see Annex II of this OU work plan and the ER Program's generic QAPjP. Laboratory protocol for sample analysis will be performed according to the EPA's "Test Methods for Evaluating Solid Waste," SW-846 (EPA 1987, 0518), for organic compounds and metals. Radionuclide, high-explosive, or miscellaneous analyses will employ acceptable analytical methods as outlined in the IWP.

Level IV data quality will be used as appropriate for confirmation of Level III or archival analytical data.

Level V analyses can include measurements for nonconventional parameters, method modifications, analyte suites from 40 CFR 261 or 40 CFR 264, physical testing of soils or rock, or other nonstandard methods that may be employed in the TA-15 RFI. Quality control and documentation for Level V will be equivalent to procedures defined for Level III so that the defensibility and quality of data are maintained.

If required, selection of analytical methods and data quality levels for COCs that have background or action levels below standard minimum detection limit (MDL) or practical quantitation limit (PQL) will be determined by the Laboratory's ER Project Office.

4.7.1.2 Phase II Analytical Levels

Phase II analytical levels are similarly organized to those used in Phase I.

4.7.2 Analytical Methods and PARCC Parameters

Analytical methods selected for the analysis of soil, water, or air samples to be collected during the TA-15 RFI will follow standard laboratory protocol recognized by the EPA (see Table 4.7-3). The analytical methods include a variety of techniques that may apply to over 300 individual analytes. Volatile and semivolatile organic compounds, PCBs, and inorganic metals will be tested and evaluated according to the EPA's "Test Methods for Evaluating Solid Waste," SW-846 protocol (EPA 1987, 0518). Analyses for radionuclides, HEs, and miscellaneous analytes will be performed under other acceptable analytical methods.

Tables V.3 through V.12 and IX.1 in the Laboratory's generic Quality Assurance Project Plan (QAPjP) (LANL-ER-QAPjP) contain additional information concerning analytical methods for constituents of interest at the TA-15 OU. The QAPjP lists the individual constituents analyzed under each method, the corresponding chemical abstract service numbers, and PQL or MDL for each constituent.

PARCC parameters are analytical, sampling quality assurance goals that are established to ensure that quality data are generated. A thorough discussion of

TABLE 4.7-3

SUMMARY OF EXAMPLES OF ANALYTICAL METHODS FOR THE ANALYSIS OF SAMPLES COLLECTED AT THE TA-15 OU

EPA Methods	
• EPA SW-846 Method 8080	Organochlorine pesticides and PCBs
• EPA SW-846 Method 8240	Volatile Organic Compounds (VOCs)*
• EPA SW-846 Method 8270	Semivolatile organic compounds (SVOCs)*
• EPA SW-846 Method 6010	Inorganic metals by inductively coupled plasma/mass atomic emission spectrometry (ICP)
• EPA SW-846 Method 7000	Inorganic metals by atomic absorption (AA)
Radionuclides - LANL or DOE Methods[a]	
• Gas flow proportional counting	Gross alpha, gross beta
• Gamma spectrometry	Am-241, Cs-137, gross gamma, Pa-234m
• ICP/MS	Total uranium
• Neutron Activation Analysis (NAA)	Total uranium
• Alpha spectrometry	U, Pa-234m

Other Methods

- High explosives - USATHMA high-performance liquid chromatography (HPLC)*
- Miscellaneous analytes*
- Physical testing of soil or rock - ASTM+ protocol

*Refer to the Laboratory's ER QAPjP for additional information.
+American Society for Testing and Materials.

the PARCC parameters for the Laboratory's ER Program is presented in Section 5.0 of the generic QAPjP.

4.7.3 Sample Collection Quality Requirements

Numerous field activities impact the overall data quality for an environmental restoration program. The activities that have a direct effect on data quality include equipment calibration schedules and procedures, sample method selection and technique, sample containers, preservatives, sample holding times, the number or type of quality control samples, sample documentation, and equipment decontamination. To ensure that data quality is maintained in the field, investigators must heed the specific details for each of these activities as addressed in Annex II of this OU work plan (QA Project Plan), in the generic QAPjP Plan for the Laboratory's ER Program and in the Laboratory's standard operating procedures (SOPs) manual for the ER Program.

4.7.4 Assumptions on OU 1086 Sampling

1. Samples will be collected with drive sampler (thin-well tube sampler "driven" by hand into sampling media). SOP-6.10
2. Samples (except for VOAs) will be homogenized in the Field (ie. - duplicate samples collected for all except VOAs-where colocated are collected).
3. Reagent and field blanks will not be used or collected.
4. Trip blanks will only be used as the per cooler on VOA samples only.
5. QC samples (inc. duplicates, rinse blanks, and trip blanks) can be combined across PRSs with small numbers of samples. However, the number of QC samples indicated does not address this and is therefore a maximum number of required QC samples.
6. QC samples are not matrix dependant (ie: subsurface is not different than surface).
7. Rinse blanks can be screened in the Field. If not the Field analyses can be deleted from the rinse blank samples.

CHAPTER 4 REFERENCES

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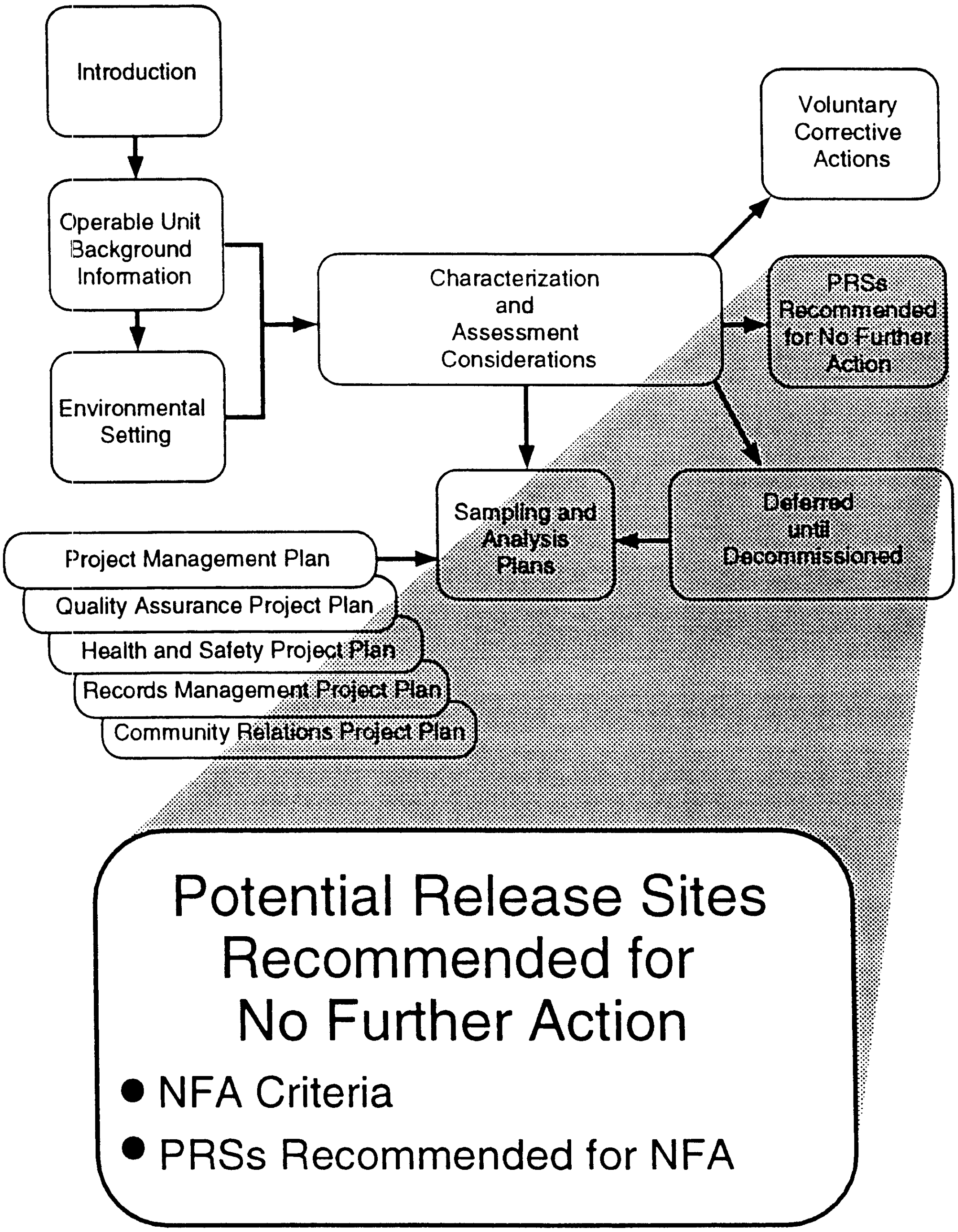
CHAPTER 5



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5.0 POTENTIAL RELEASE SITES RECOMMENDED FOR NO FURTHER ACTION

All Potential Release Sites (PRSs) in Operable Unit (OU) 1086 will be evaluated according to the decision process presented and discussed in Chapter 4, at Section 4.1 Decision Point 1 of the decision process, some PRSs are recommended for no further action (NFA). These recommendations are made on the basis of available archival information that indicates that those PRSs pose no potential threat to human health or the environment. A discussion of the criteria used to support a recommendation of NFA for each of these PRSs is provided in Section 5.2.

5.1 Introduction

A PRS can be either a Solid Waste Management Unit (SWMU) or an area of concern (AOC), the latter not fitting the legal (RCRA) definition of a SWMU.

The Hazardous and Solid Waste Amendments (HSWA) Module (EPA 1990, 0306) defines SWMU 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. Such units include any area at or around a facility at which solid wastes have been routinely and systematically released.

5.2 Criteria for No Further Action

According to Subpart S to the Code of Federal Regulations (CFR) 264 (EPA 1990, 0432), a PRS can be recommended for NFA if it can be demonstrated that the PRS poses no threat to human health or the environment. In addition, the Installation Work Plan (LANL 1992, 0768; Appendix I, p.19) states the same requirement for NFA in the form of a question:

> Does the site present no significant health or safety risks and no other significant problems?

If the answer to this question is yes, then the site can be recommended for NFA. For OU 1086, the PRSs where the answer is affirmative are listed in Table 5.2-1 and are then considered individually. For this work plan some PRSs in OU 1086 for which the above question is answered in the affirmative are recommended for NFA without environmental sampling. This recommendation is given only after a careful examination of archival information that proves that the site poses no current or future threat to human health or the environment. The archival information has been reviewed, and a total of 24 PRSs in OU 1086 listed in the 1990 SWMU report (LANL 1990, 0145) have been proposed for NFA. In all cases, the additional evidence used for these NFA recommendations outweighs the evidence that was originally used to list the site as a PRS.

TABLE 5.2-1
POTENTIAL RELEASE SITES RECOMMENDED FOR NO FURTHER ACTION

SECTION	LOCATION	PRS	DESCRIPTION
5.3.1	The Hollow	SWMU 15-005(d)	Lead bricks
		SWMU 15-014(g)	Cooling water outfall
		SWMU 15-005(a)	Boiler room
		SWMU 15-009(a)	Septic tank
		AOC C-15-008	Site of clear liquid
5.3.2	R-183	SWMU 15-008(e)	Pile of dirt
		SWMU 15-014(c)	Sink drain
		AOC C-15-002	Pile of excavated dirt
5.3.3	R-40	SWMU 15-009(d)	Building drain
		SWMU 15-010(a)	Site of septic tank
		AOC C-15-009	Underground butane tank
5.3.4	PHERMEX	SWMU 15-013(a)	Site of underground tank
		SWMU 15-013(b) (aka C-15-012)	Site of underground tank
		SWMU 15-014(d) and (l)	Outfall
		SWMU 15-014(e)	Outfall
		AOC C-15-013	Underground storage tank
5.3.5	R-45	SWMU 15-007(c) and (d)	Shafts
		SWMU 15-014(f)	Drainlines
		AOC C-15-003	Black granular material
5.3.6	Firing Site C	SWMU 15-004(e)	Firing Point D
5.3.7	Ector	SWMU 15-014(m)	Outfall and drainline
5.3.8	Unlocated	SWMU 15-004(i)	The Gulch
		SWMU 15-012(a)	Discarded pump oil

5.3 Potential Release Sites Recommended for No Further Action

5.3.1 Potential Release Sites in The Hollow

See site map, Figure 5.3-1.

5.3.1.1 SWMU 15-005(d); Lead Bricks

In the area known as "The Hollow," a small building, TA-15-30, is presently used for chemical storage. During the 1988 environmental restoration (ER) site reconnaissance visit (LANL 1989a, 0861; LANL 1989b, 0862; LANL 1989c, 0863), lead bricks were noted stacked by this building [SWMU 15-005(d)]. This was a temporary storage location, the number of lead bricks was small. The bricks have been removed and the area has been covered with asphalt. This information indicates that it is highly unlikely that release occurred from these lead bricks in quantities sufficient to be hazardous to occupational workers or future receptors. This SWMU is therefore recommended for NFA.

5.3.1.2 SWMU 15-014(g); Outfall from Cooling Water

This SWMU is an outfall located 11 ft east of the northwest corner of building TA-15-203. It is a drain that was used for once-through cooling water to an air compressor. The water drained into a ditch emptying into Cañon de Valle. This outfall currently has EPA permit 04A093. The air compressor has been taken out of service and removed (Francis 1992, 10-0002). Since no potentially hazardous materials were introduced into this water, this SWMU is recommended for NFA.

5.3.1.3 SWMU 15–005(a); Container Storage Area

The storage area, SWMU 15–005(a), is located in room ER126 of building TA-15-20. It was reported to have been used for storing lead. It is, in fact, a boiler room containing a boiler, compressor, and air ventilation equipment. The room was inspected in May 1993. There were no signs of lead bricks. We recommend this SWMU for NFA.

5.3.1.4 SWMU 15-009(a); Septic Tank

SWMU 15-009(a) is a septic tank located 8 ft 6 in. south of the southwest cover of building TA-15-50. Its structure designation is TA-15-51. It was constructed in 1949 of reinforced concrete. The influent is sanitary waste from building TA-15-20 and from a sink and water fountain in building TA-15-50 (Francis 1992, 10-0002). There is no evidence of any hazardous materials being disposed of here. The New Mexico State Environmental Improvement Division (EID) unpermitted individual liquid waste system number is LA-15. The effluent flows west about 85 ft to a 4-ft diameter by 50-ft-deep seepage pit constructed in the mid-1970s. Before that time, effluent went to an outfall located at the edge of Water

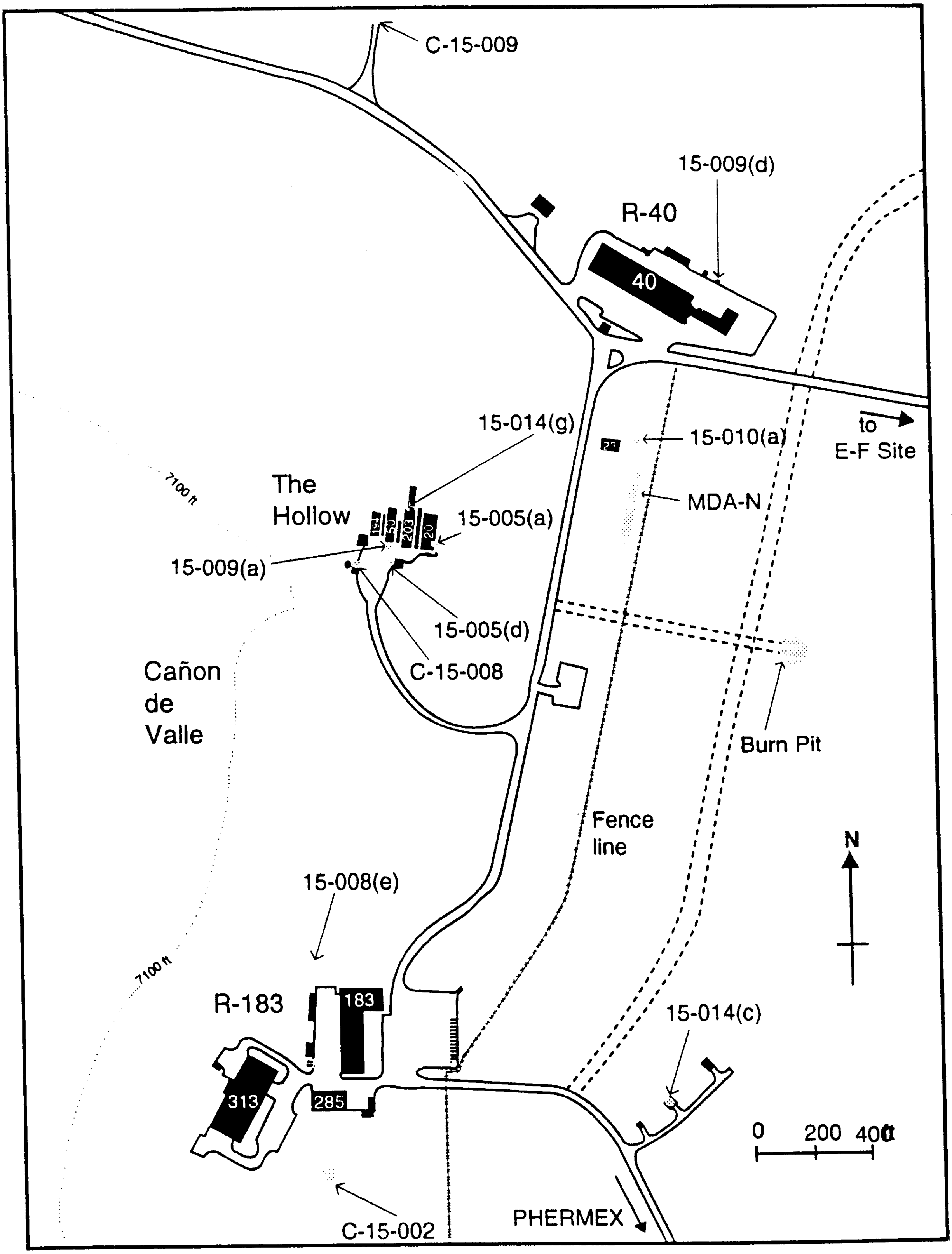

Figure 5.3-1 Site map showing The Hollow, R-183, and R-40 with PRSs recommended for NFA.

Canyon. This septic tank was sampled in 1981 for high explosives (HEs) and none were detected. This SWMU is recommended for NFA.

5.3.1.5 AOC C-15-008; Pool of Water

This clear liquid was reported during a site visit in 1988. However, during a site visit in 1992 no liquid was seen, no residue was apparent in the general area and there were no identification marks of where the clear liquid had been seen. Given the general location of C-15-008–on the edge of the parking lot–it is likely the puddle was water. No quantities of colorless liquid compounds are used at The Hollow. Because of the lack of evidence for contaminants and lack of knowledge of exact location of AOC C-15-008, NFA is recommended.

5.3.2 Potential Release Sites at R-183

See site map, Figure 5.3-1.

5.3.2.1 SWMU 15-008(e); Pile of Dirt at TA-15-194

The Laboratory's SWMU report (LANL 1990, 0145) lists a dirt mound [SWMU 15-008(e)] being present over the leach field of septic system TA-15-195. The ER site reconnaissance visit (LANL 1989a, 0861; LANL 1989b, 0862; LANL 1989c, 0863) describes the mound as 10 ft x 10 ft x 4 ft with concrete and pipe debris. This mound was a construction mound during the construction of the leach field, and was removed after construction was completed.

In 1992 no dirt mound was found with concrete and pipe debris. The exact location of where the dirt mound was is not known. This SWMU is recommended for NFA because it no longer exists.

5.3.2.2 AOC C-15-002; Pile of Excavated Dirt

Between 1978 and 1980, the area, where building R-285 was later constructed, was excavated in order to lay the foundations for building R-285. The dirt from the excavations was piled (Mason 1993, 10-0040) at the location that became C-15-002. The main mound is about 15 ft high and 100 ft long. There are four smaller mounds just to its south, about 5 ft by 5 ft. There is no reason to expect contamination in these mounds and NFA is recommended.

5.3.2.3 SWMU 15-014(c); Sink Drain

SWMU 15-014(c) is a sink drain exiting building TA-15-242 at the rear and emptying on the ground on the north side of the building.

Building TA-15-242 is used to store HEs and to assemble HEs around the experimental firing system. No machining of HEs, however, occurs in this building and the HEs are never in solution, making spills unlikely. The sink, now deactivated, was used for simple operations such as washing hands. Because no measurable quantities of HEs are expected in this drain area, this SWMU is recommended for NFA.

5.3.3 Potential Release Sites at R-40

See site map, Figure 5.3-1.

5.3.3.1 SWMU 15-009(d); Building Drain

This drain, on the north side of building R-40, drains that part of R-40 which contains offices only (and auxiliary rooms, such as conference rooms, coffee rooms etc). There have never been any laboratories associated with this part of R-40 and therefore no hazardous wastes. We recommend NFA.

5.3.3.2 SWMU 15-010(a); Septic Tank

A septic tank TA-15-80 [SWMU 15-010(a)] was built in 1944 and connected to building TA-15-1 (ENG-C 12813 1944, 10-0018). It was later connected to a relocated building TA-15-23 (ENG-C 17352 1957, 10-0020). Engineering drawing-R 5110, 1983, lists the building TA-15-1 as having been removed in 1962, and the septic tank (TA-15-80) abandoned in 1961. In 1965 this septic tank, along with many other structures on TA-15, was surveyed and found to be free of HEs and radioactive contamination (Courtright 1965, 10-0034) and was removed and disposed of in 1967.

This septic tank has been removed and the area soil regraded. This SWMU is recommended for NFA because no HEs or radioactivity was found on the tank when it was disposed of.

5.3.3.3 AOC C-15-009; Underground Fuel Tank

An underground fuel tank (butane), TA-15-48 (AOC C-15-009), is currently located a few feet north and west of building TA-15-8 (see EXEC 3 and topographical map Appendix A). This tank, although marked at the site, is not on the Laboratory's Underground Tank List. Because butane is not hazardous, we recommend NFA for this AOC.

5.3.4 Potential Release Sites at PHERMEX

See site map, Figure 5.3-2.

5.3.4.1 SWMU 15-013(a); Underground Tank

This tank had a structure designation TA-15-192. It was an aboveground 1036-gal. propane tank, which was removed from TA-15 in December 1959 (Francis 1992, 10-0002). The tank was relocated at TA-49 and renumbered as TA-49-56. There is no documentation concerning leakage from this tank while

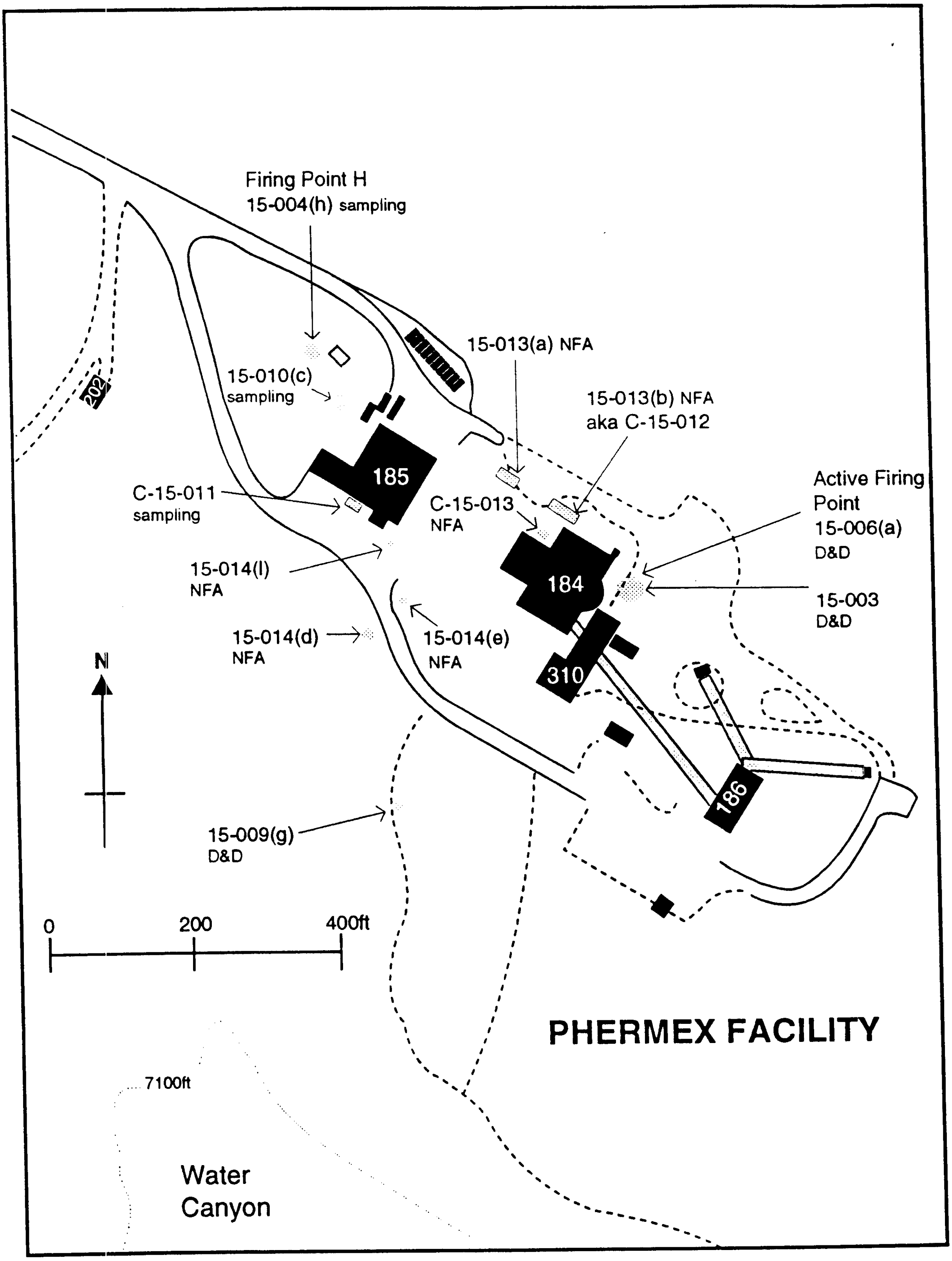

Figure 5.3-2 Site diagram of PHERMEX facility, showing all PRSs (D&D, NFA, and sampling).

it was located at TA-15. Like butane, propane is not hazardous. We recommend NFA for this SWMU.

5.3.4.2 SWMU 15-013(b); aka AOC C-15-012, Site of Underground Storage Tank

An underground 15 000-gal. tank, containing mineral oil designated TA-15-287, was located immediately north of building TA-15-184 (PHERMEX facility) (ENG-C 43075 1976, 10-0021). This tank was installed in 1977 by the Zia Company as part of the PHERMEX Enhancement Program. This tank has also been mislabeled with a second number TA-15-266 [SWMU 15-013(b)].

The necessary permits and work order were obtained and this underground storage tank was removed in October 29, 1992. Soil samples were collected from around the site and analyzed for total petroleum hydrocarbons, which were found to be 15 ppm or less (Tiedman 1992, 10-0041). Because this tank contained mineral oil, a nonhazardous material under RCRA, NFA is recommended.

5.3.4.3 SWMUs 15-014(d) and 15-014(l); Outfall or Drainline

The SWMU report of 1990 (LANL 1990, 0145) states that the use and composition of drainline material of this outfall or drainline from building TA-15 185 is unknown. Presumably the drainline has been in use since 1961 when this building was constructed; it drains surface water into Water Canyon Environmental Protection Agency (EPA). The unit, SWMU 15-014(l), is at the base of the cooling tower. No additives, including herbicides, were added to the cooling water. Water was taken directly from the main supply. Unit 15-014(d) is slightly farther from the buildings and will receive the same surface water as 15-014(l). The two units can therefore be considered together. The ace runoff and cooling water exiting these drains will be the same, neither with any obvious paths for the introduction of contaminants. We recommend NFA.

The Santa Fe Engineering, Ltd. (1991, 10-0037) report (Francis 1992, 10-0002) lists seven drainlines and outfalls from building TA-15-185. Outfalls 15-185-OPN-1 and -OPN-2 receive rainwater from a drainage system and OPN-3 receives flow from sanitary facilities and flows to a septic tank, outfall 15-185-OPN-4 is the permitted outfall (EPA 03 A028) from cooling tower TA-15-202 [SWMU15-014(l)]; OPN-5 is a gas vent; OPN-6 is a drain from a fire sprinkler system, and -OPN-7 is the outfall from five roof drains. In no case are hazardous materials suspected of being present in any of these outfalls.

5.3.4.4 SWMU 15-014(e); Outfall and Drainlines

This outfall is a yard drain located approximately 20 ft south and 6 ft east of the southeast corner of building TA-15-184 (PHERMEX facility) (Francis 1992, 10-0002). The influent is once-through cooling water and washdrains into floor drains. It is connected to the basement floor drains of building TA-15-184 by a 6-in. vitrified clay pipe. The yard drain (permitted outfall EPA 04-A139) is connected by a 12-in. corrugated metal pipe to a ditch that drains generally southward into Water Canyon (see Figure 6.2-1). Because no hazardous materials are expected in this outfall, NFA is recommended.

5.3.4.5 AOC C-15-013; Underground Storage Tank

An inactive, 200 gal. underground storage tank, used in the past for ethylene glycol, is located near building TA-15-184 (ENG-C 43075 1976, 10-0021, sheet 6 and 10 of 26). The tank is fiberglass and was installed by the Zia Comnpany in 1977 as part of the PHERMEX enhancement program. Because this tank is not in use and ethylene glycol is not regulated under RCRA, we recommend NFA.

5.3.5 Potential Release Sites at R-45

See Site Map, Figure 5.3-3

5.3.5.1 SWMUs 15-007(c) and 15-007(d); Shafts

In 1972 two 6-ft-diameter by 130-ft-deep vertical shafts were dug into the tuff approximately 300 ft east of building TA-15-263 at Firing Site R-45 (Figure 5.3-4). Both shafts, TA-15-264 [SWMU 15-007(c)] and TA-15-265 [SWMU 15-007(d)] were used in one-time tests of the feasibility of carrying out explosive tests confined by the tuff itself at TA-15. The explosions were confined to the bottom of the shafts; the shafts being backfilled with magnetite, Cal-Seal cement, sand grout, bentonite, sand, and gravel.

For the one-time test at TA-15-264 [SWMU 15-007(c)] approximately 2 tons of HEs were detonated at the bottom of the shaft. Because of the depths (130 ft) of these contaminants, there are no reasonable pathways to receptors. This test used only HE and was designed to test the ability of tuff to absorb the explosive shot.

For the one time test carried out in shaft TA-15-265 [SWMU 15-007(d)], the explosion was somewhat different. Less HE was used (500 lb); approximately 400 Ci of tritium and less than 200 g of beryllium were used. The 400 Ci of tritium is about 10% of the airborne annual releases of tritium from the Laboratory in 1990 (Environmental Protection Group 1992, 0740). The explosion was confined in the same manner as mentioned previously for shaft TA-15-264.

Tritium has a half-life of radioactive decay of 12.26 yr. After each 12.26-yr period, the amount of tritium remaining is one-half that present at the beginning of that 12.26 yr period giving a current maximum concentration of about 120 Ci. or about 3% of the airborne annual releases of tritium. Given the assumption that this area will be under some governmental control for up to 100 yr, tritium in this shaft and surroundings will not be a potential hazard in the event that the area reverts to public recreational use.

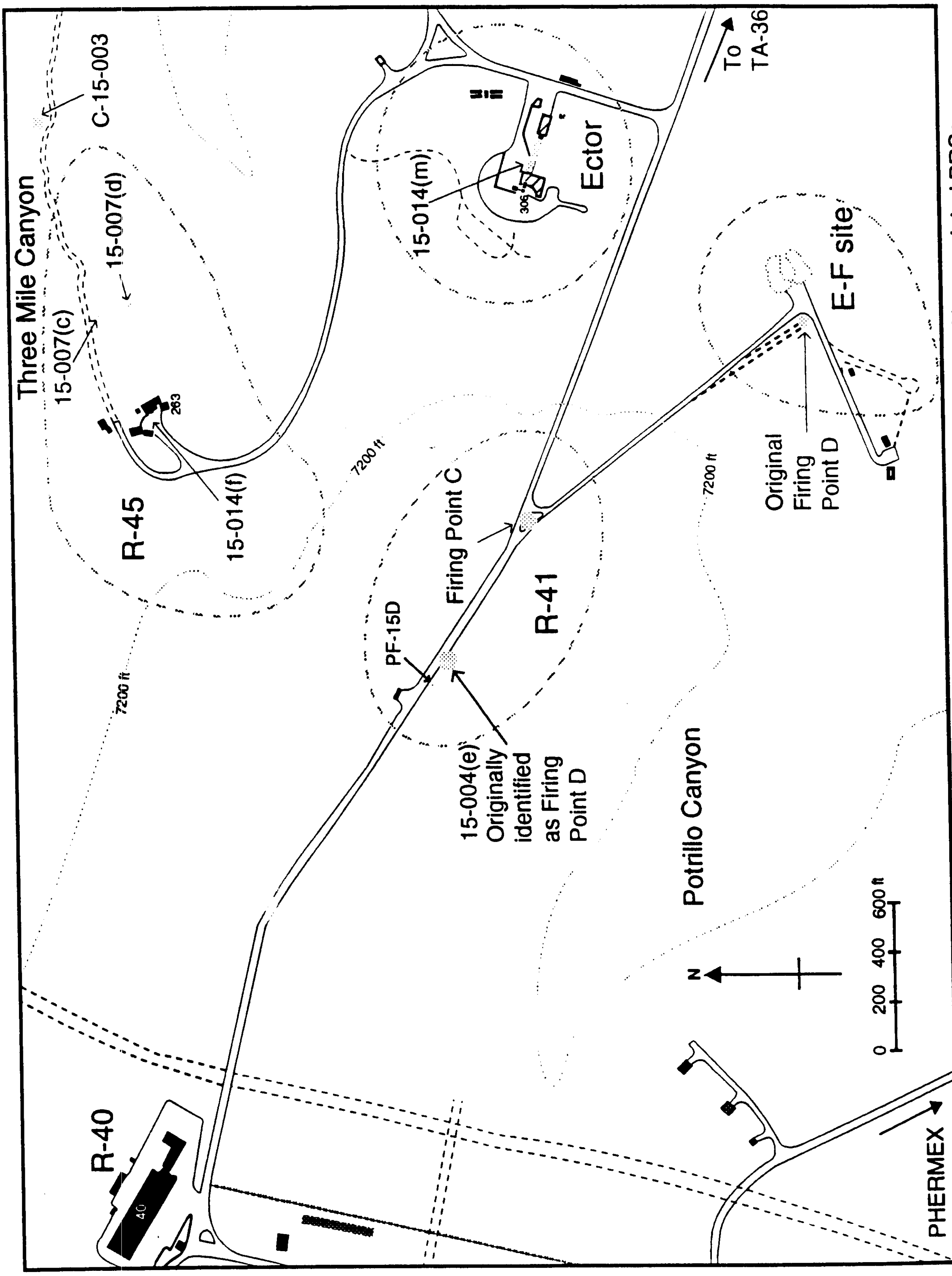

Figure 5.3-3 Site diagram for Firing Sites R-41 (Firing site C), Ector, E-F site, and R-45 with associated PRSs recommended for NFA.

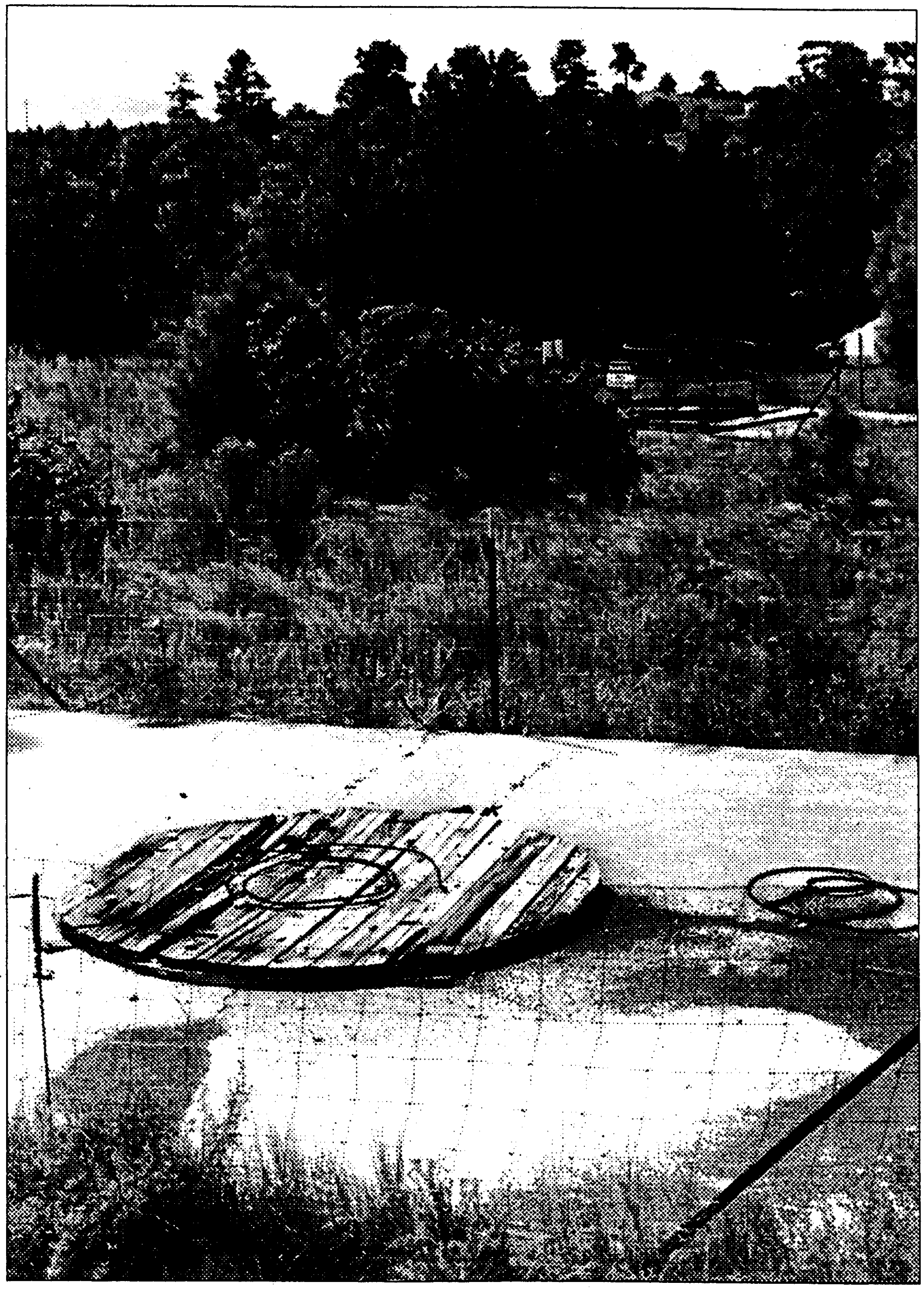

Figure 5.3-4 Surface view of shaft experimental areas. In the background is 15-007(d) and in the foreground is 15-007(c). A few small pieces of lead shot are visible around 15-007(c). The areas are covered and fenced. They are remote from the rest of the site and are surrounded by full vegetative growth (photograph taken July 1992).

In the deep, back-filled shafts, beryllium and lead are not potentially hazardous. The less than 200 g of beryllium, if mixed with approximately 1000 tons of soil from such an explosion (explosions cause extensive mixing), would be below the 40 CFR 264 action level of 0.2 mg/kg for beryllium in soil. This is not an unreasonable prospect given that 500 lb of HEs were used in this test. In addition, the estimate of 0.2 mg/kg of beryllium in soil is conservative because it is an action level based on residential rather than recreational usage. The background level of beryllium has been found to be 4.7 mg/kg for tuff and 2.4 mg/kg for soil. The additional beryllium changes the loading by not more than 8%. The likelihood of someone digging up the backfill with beryllium is also low. SWMUs 15-007(c) and 15-007(d) are recommended for NFA, because of low source term quantities and no reasonable pathway to receptors.

5.3.5.2 SWMU 15-014(f); Drainlines and Outfalls

This SWMU is located 5 ft south and 13 ft east of the southwest corner of building TA-15-263. It empties into a ditch that runs into Three-Mile Canyon. Once-through cooling water is the only source of liquid for this outfall. This outfall is covered by EPA permit no. 04A 121 (Francis 1992, 10-0002). Since no hazardous material has been emptied into this outfall and it is currently regulated by other statutes, NFA is recommended.

5.3.5.3 AOC C-15-003; Pile of Black Granular Material

Examination of this pile of black granular material located approximately 500 ft east of shaft TA-15-264 [SWMU 15-007(c)] confirmed that it is magnetite. Magnetite is an iron oxide that occurs naturally in great abundance and is not considered a hazardous material. This magnetite was put here as backfill material used in the shaft experiments (Subsection 5.3.5.1).

No further action is recommended for this AOC.

5.3.6 Potential Release Site at Firing Site C

See site map, Figure 5.3-3.

5.3.6.1 SWMU 15-004(e); Firing Point

SWMU 15-004(e) is not a firing site; it is a manhole bunker for electric cables. It was wrongly identified (see Figure 5.3-3). Engineering drawing ENG-R 703, 1955, places Firing Point D [SWMU 15-004(e)] 140 ft south and 115 ft east of the southwest corner of building TA-15-41. This location is a manhole/bunker (TA-15-34/98) (ENG-C and ENG-C 39), from which electrical cables changed from above ground to below. The manhole/bunker was partially below ground and covered with a berm.

A surface sample (PF-15D) was taken and analyzed as part of the Sanitary Wastewater Systems Consolidation (SWSC) project (Fresquez 1991, 10-0003) (see Figure 5.3-3). Gross alpha, beta, and gamma activity were at background levels, and toxicity characteristic leaching procedure (TCLP) (Ag, As, Ba, Cd, Cr, Hg, Pb, and Se) metals were below EPA guidelines. Also, no semivolatile organic compounds (SVOCs) were detected. Total beryllium and uranium levels were at background levels. This SWMU is recommended for NFA.

5.3.7 Potential Release Sites at Ector

See site map, Figure 5.3-3.

5.3.7.1 SWMU 15-014(m); Outfall and Drainline

This drainline and outfall handles noncontact cooling water from building TA-15-306 (Ector facility) (Figure 5.3-2) and is permitted under EPA 04A143. The drainline is 1.5 in. PVC pipe fastened to the north wall of building TA-15-306. It empties into a roadside ditch, which is graded in the direction of Potrillo Canyon. NFA is recommended for this SWMU because hazardous materialshave not been used in the past and current discharges are regulated under non RCRA statutes.

5.3.8 Unlocated

5.3.8.1 SWMU 15-004(l); "The Gulch"

A single report (Linschitz 1944, 0790) has been located that states that two test blasts were conducted in 1944 in "The Gulch," approximately 1 mile below R-site at an unknown precise location. Because the location of the site is ill defined and only two tests were performed we recommend NFA.

5.3.8.2 SWMU 15-012(a); Discarded Vacuum Pump Oil

The location of SWMU-012(a) has never been determined. Because the amount of pump oil must be small in order for it not to be detected, we recommend NFA.

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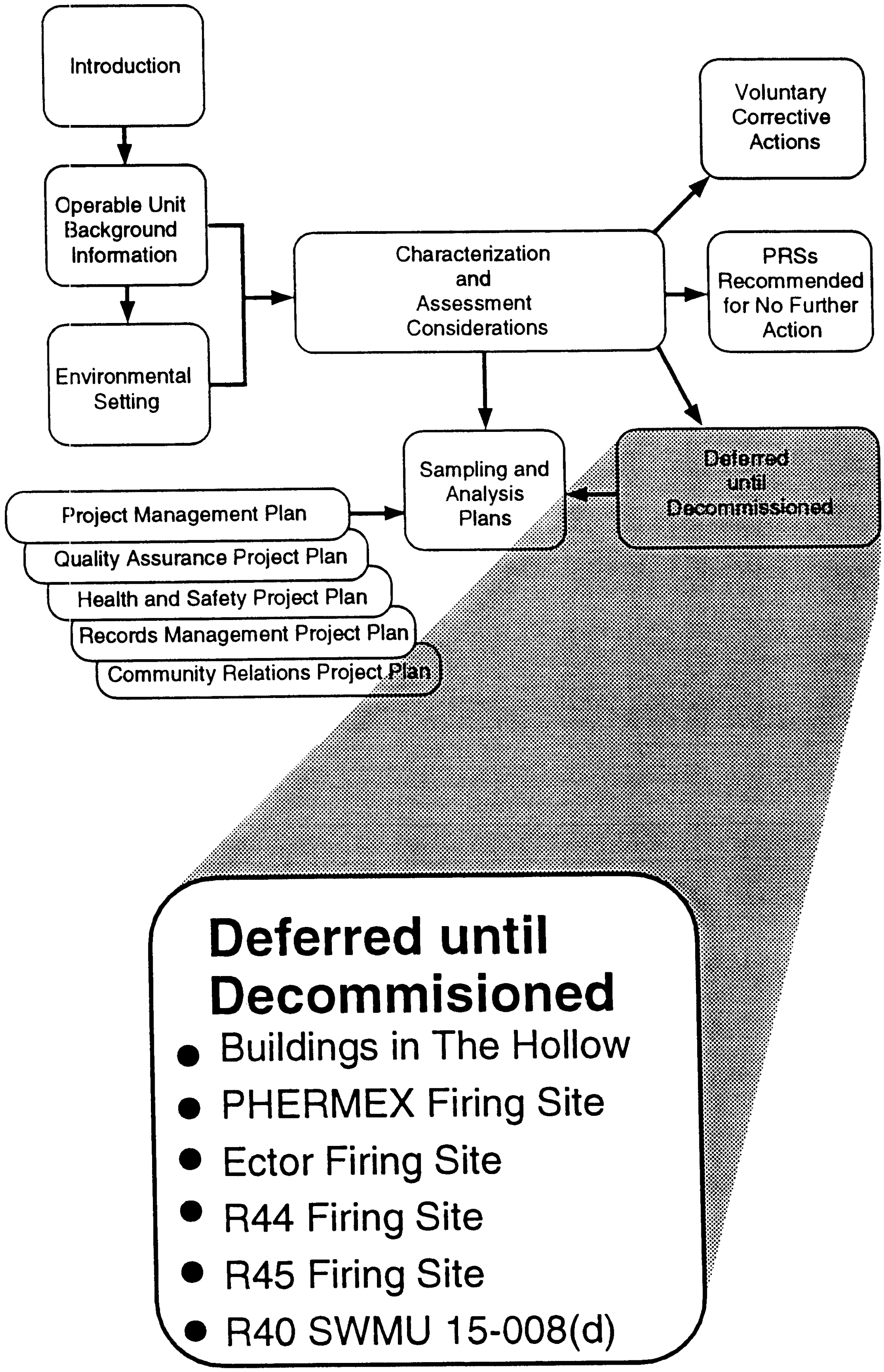
CHAPTER 6



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6.0 SOLID WASTE MANAGEMENT UNITS TO BE DEFERRED FOR ACTION UNTIL DECOMMISSIONED

Section 4.5.3 and Figure 4.4-1 describe the process by which the RFI and corrective measures of specific sites in Operable Unit (OU) 1086 can be deferred until the sites are decommissioned. This process applies to units for which there is no current health-based risk to occupational workers or to off-site receptors. All current workers at TA-15 are routinely monitored for radiological contamination, and each wears a thermoluminescent dosimeter (TLD) badge and protective clothing (normally bootees) when working on potentially contaminated ground.

This chapter lists the active sites at OU 1086 together with their associated potential release sites (PRSs) that will be deferred for characterization, even though active sites used for detonation of explosives as part of research activities are not classified as solid waste management units (SWMUs) (Corpion 1992, 10-0043).

6.1 Introduction

Because of continuing experimental use, the location and concentration of hazardous materials can change with time on a site such as a firing point. There is little reason, therefore, to prepare sampling plans at this time for identified PRSs for given sites as long as hazardous materials remain below concentration levels considered to be safe for occupational workers [Code of Federal Regulations (CFR) 29 CFR 1910] (OSHA 1991, 0610) and as long as the hazardous materials are not migrating off laboratory property (according to 40 CFR 264) (EPA 1990, 0432).

Section 4.3 and Appendix F details the process used in carrying out a health-based risk assessment specifically for PHERMEX, (Pulsed, High-Energy, Radiographic, Maching Emitting X-Rays) Facility, which is the most actively used firing site. Guidelines for screening action levels to recreational user scenarios as well as surface contamination levels of uranium, beryllium, and lead to which occupational workers can be safely exposed are provided. Subsection 4.3.4 and Appendix F show that only beryllium is a potential hazard to occupational workers on a TA-15 firing site. The calculated acceptable beryllium concentration (429 μg/g) is a factor of 13 greater than the average beryllium concentration in soil at PHERMEX.

Surveillance measurements of depleted uranium (DU) and beryllium must be made periodically to ensure that concentrations are not exceeded.

There are two types of sites (where there is no current health-risk to occupational workers) that could fit into the deferred until decommissioned (D&D) status:

1. Sites actively being used in support of the Laboratory mission on which the concentration of hazardous materials may be changing in concentration through this occupational use, and

2. Inactive sites or SWMUs where the concentration of hazardous materials is changing due to activities at a nearby active site.

A related question is raised, if we consider deferring characterization until decommissioning primarily due to future changes in contamination levels: Are the current levels of contamination exiting the site below screening action levels? Since TA-15 is surrounded by Laboratory property, even if contaminants leave TA-15, they will not exit laboratory property.

There are two main ways contamination migrates:

1. Through aerosolization — Studies carried out in 1976 suggest that aerosolization accounts for 10% of uranium leaving the site (Dahl and Johnson 1977, 0877). This was calculated from a limited data set. Studies are currently underway to repeat and enlarge the experimental data. In the next year, provided adequate funding is received, we will have a much better understanding of the process.

   A test performed at PHERMEX in 1992 is being reanalyzed. This test contained elemental tracers as well as depleted uranium. The test was performed for other purposes, but will be reanalyzed to look at the dispersion of uranium from the shot. Filter samples were collected using aircraft, balloon, and ground-based platforms. Reanalysis of these data will give us good estimates of the uranium inventory from the device and will help us define the parameters for the shot to be performed next year.
2. Through hydrologic draining away from the mesa top — Although hydrologic data has been collected from the mesa, we are proposing to systematically study the drainage. During the next fiscal year, in order to understand current movement of contaminants, we plan to evalute past data and then take additional data, provided adequate funding is available.

When these two studies are complete, we will be in a more informed position to answer the question concerning the current level of contaminants of concern (COCs) leaving the mesa and whether remediation plans should be initiated before decommissisning. Similar studies at other active firing sites are currently underway.

In addition, two studies are currently underway at the PHERMEX site. Although not directly sponsored by the environmental restoration (ER) program, their charter is such that the results will be of value to ER efforts.

They are

1. A Corrective Activities Program to characterize the active Resource Conservation and Recovery Act (RCRA) firing site at PHERMEX (Mason 1993, 10-0046). This study will measure what RCRA hazardous base constituents are eroding off the site and will include toxicity characteristic leaching procedure (TCLP) metals, uranium, beryllium, semivolatile organic compounds (SVOCs) and HEs. This program is expected to be completed in the summer 1993.

2. A study to comply with the new radiological contamination manual. PHERMEX is being studied to develop guidelines for the control of DU in outside areas (Mason 1993, 10-0046).

Therefore, it seems reasonable to wait until these studies are finished before characterizing the active firing sites.

Active sites and related PRSs for which this RFI Work Plan is proposing that characterization be deferred until decommissioned are:

1. PHERMEX— SWMUs 15-003, 15-006(a), and 15-009(g). Section 6.2
2. R45— SWMUs 15-006(d), 15-008(g), 15-009(b). Section 6.3
3. R44— SWMUs 15-006(c), 15-009(c). Section 6.4
4. Ector— SWMU 15-006(b), 15-009(h). Section 6.5
5. R40— SWMU 15-008(d). Section 6.6

PRSs at active sites for which sampling plans have been developed later in this work plan include the following:

1. All PRSs in The Hollow (except those in Chapter 5, NFA)
2. PHERMEX [SWMU 15-004(h)]
3. R44 [SWMU 15-008(b)]
4. R40 [SWMU 15-014(h)]

6.2 PHERMEX Facility SWMUs 15-003, 15-006(a), 15-009(g)

6.2.1 Site Description

For the past two decades, PHERMEX Facility (Figure 6.2-1) has been used to examine the performance of new Los Alamos nuclear weapon designs and all major changes to stockpile weapons through a process called dynamic radiography. In dynamic radiography, PHERMEX is used to produce extremely short-duration bursts of X-rays. After passing through the test object during the explosion, the X-rays are recorded on film as an image of the test device at a preselected time.

Although PHERMEX does have an interim status permit for disposal by detonation of waste HE scraps, the facility has never been used for this purpose. The SWMU associated with this activity is 15-003. SWMUs 15-006(a) and 15-003 are at the identical location at PHERMEX and should be included as a single SWMU.

6.2.2 Potential Source Terms

As a firing site, PHERMEX has the potential for depleted uranium (DU), beryllium, lead, mercury, thorium, and residual HE contamination. Because HE contamination has not been observed at firing sites such as these on TA-15 (DOE 1989, 0271), the likelihood of HE contamination being found here is small. Experiments at TA-15 were not intended to investigate explosives but, rather they used explosives with well-established properties, making residual

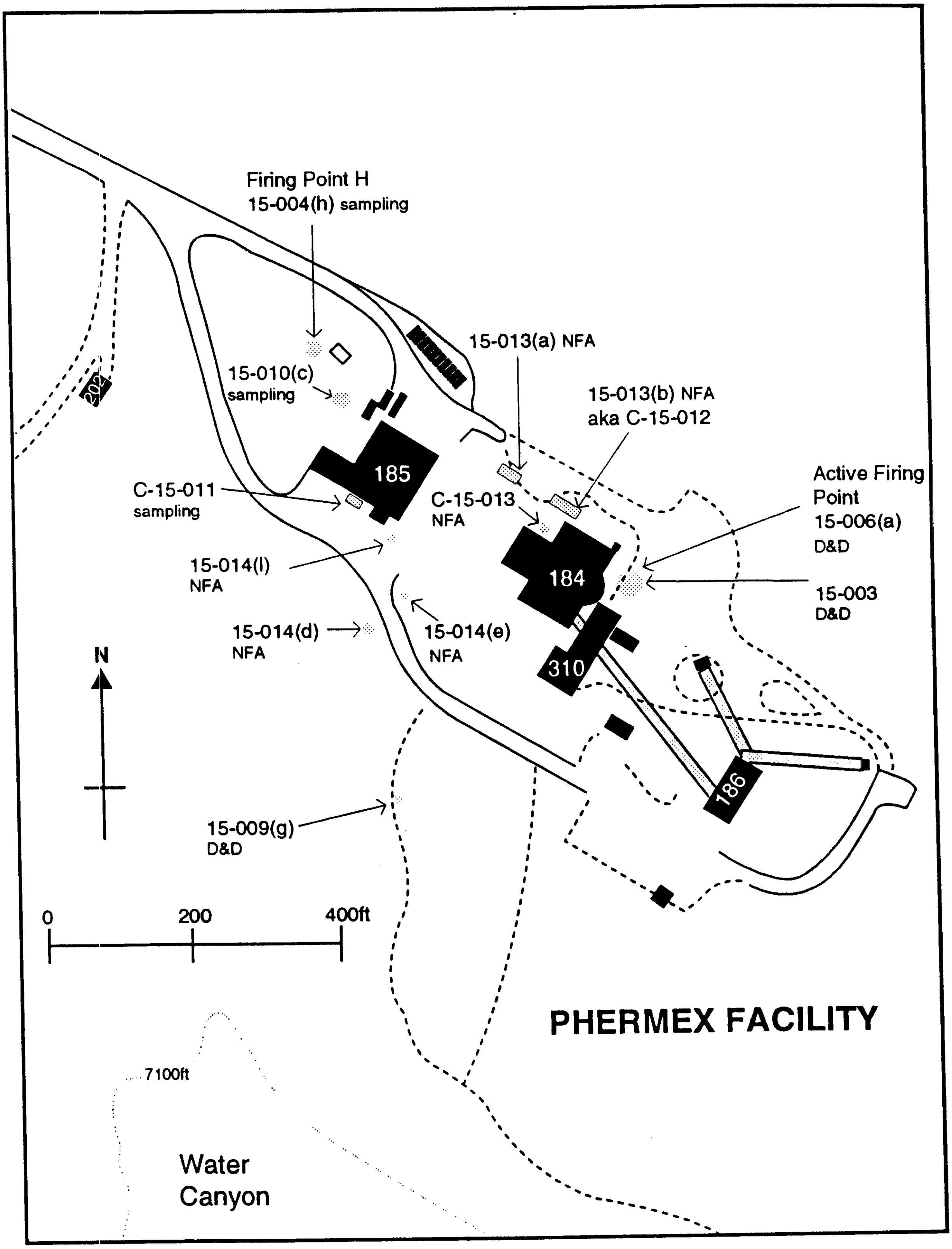

Figure 6.2-1 Site diagram of PHERMEX facility, showing all PRSs (D&D, NFA, and sampling).

HE contamination unlikely. Nevertheless, spot tests for HEs should be undertaken at D&D.

During the time period 1961 through 1971, a maximum of 4000 kg of depleted uranium was expended on the PHERMEX site (Venable 1990, 10-0010). During that same time period, about 150 kg of beryllium, 250 kg of lead, 40 kg mercury, and 40 kg of thorium were expended. Since 1971, less than 1000 kg per year of uranium-238 has been expended on the PHERMEX firing site. Beryllium usage has decreased from about 10 kg per year in 1971 to about 3 kg per year in 1987.

The EG&G aerial survey results [Fritzsche 1989, 10-0033 (Appendix H)] show that in 1982 the PHERMEX site contained the second largest concentration of Pa-234m (and thus U-238) in the soil surface of all the firing sites on OU 1086. These results were used to estimate that PHERMEX contained one-seventh of the amount of radioactive material on Firing Site E-F. This is within a factor of 2 of the ratio estimate from maximum possible expended quantities of uranium from inventory lists (Venable 1990, 10-0010). This is reasonable confirmation of the quantity of uranium on these two firing sites. Of the two firing sites, only the PHERMEX site has been used since 1982.

In the radiological survey of TA-15 conducted in 1991 (Schlapper 1991, 10-0009), contact exposure rates from background to as high as 5 mR/h could be found at selected locations on steel blast shields or mats at the PHERMEX firing point. These rates are due to the presence of large chunks of depleted (DU) that were scattered during the explosions.

6.3 Firing Site R-45

6.3.1 SWMUs 15-006(d), 15-008(g), 15-009 (b)

Firing Site R-45 (Figure 6.3-1) is the least used of the active firing sites on TA-15. The area was originally built in 1951 and has been used only for small quantities of explosives. Two experimental firing points at this location shown in Figures 6.3-2 and 6.3-3, and the existence of nearby trees attest to the small size of the explosions conducted at this site. The sandbags [SWMU 15-008(g)] are considered to be part of the firing site SWMU [15-006(d)] and not as a separate SWMU. The septic system, SWMU 15-009(b) is also included in Firing Site R-45. It was last used in the fall of 1992 for special small experiments using less than 1 lb of explosive charge.

The radiological survey of 1991 (Schlapper 1991, 10-0009) found exposure rates up to 10 mR/h at the surface of the camera building closest to the firing point. Background levels were approximately 0.1 mR/h at 30 cm distance from the building. Again, localized with radiological radings can be obtained due to the presence of chunks of uranium.

The aerial radiological survey of Fritzsche (Fritzsche 1989, 10-0033) (Appendix G) did not detect any gamma radioactivity from Pa-234m above background at Firing Site R-45.

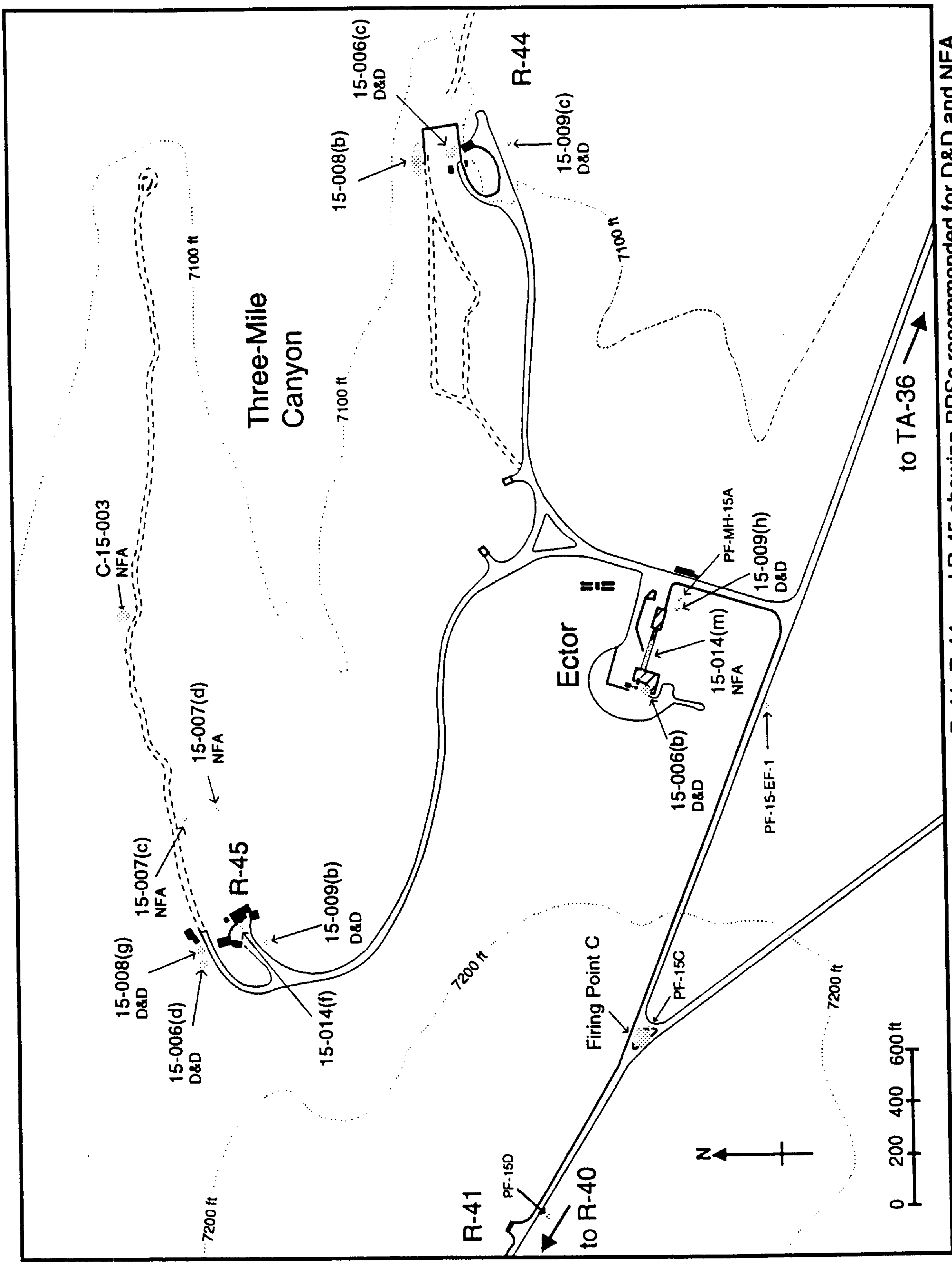

Figure 6.3-1 Site diagram for Firing Sites Ector, R-41, R-44, and R-45 showing PRSs recommended for D&D and NFA and and SWMU 15-008(b).

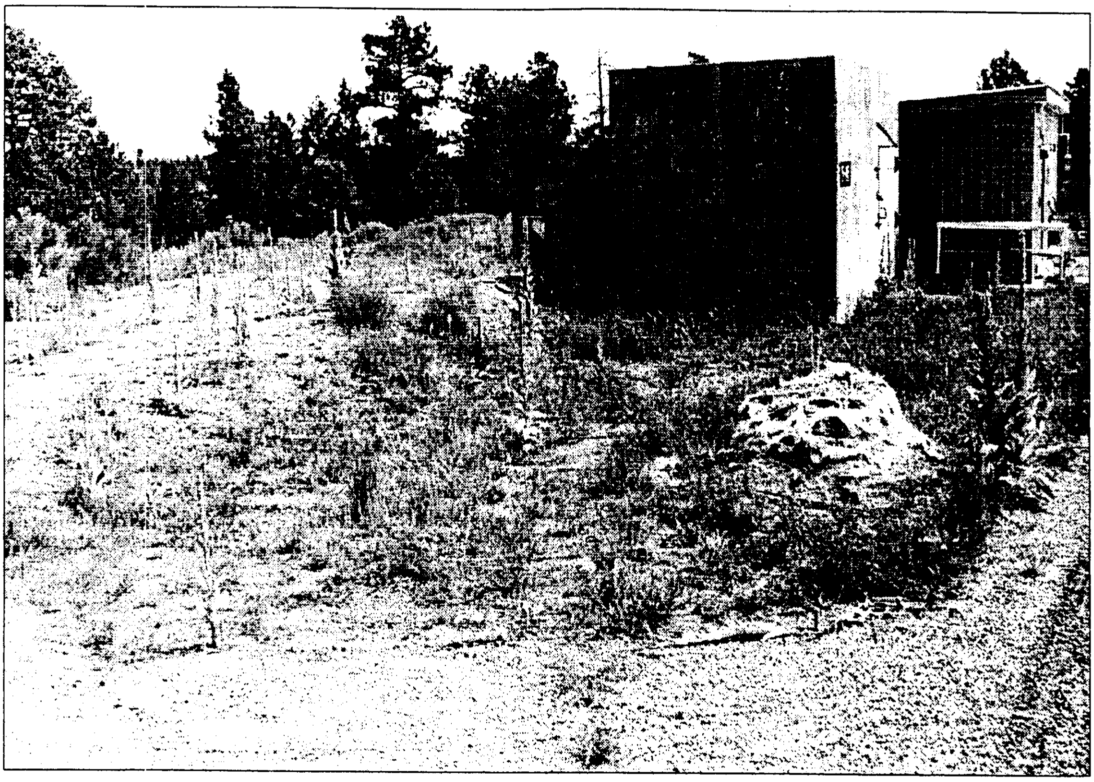

Figure 6.3-2 Firing Site R-45 looking east (photo taken July 1992).

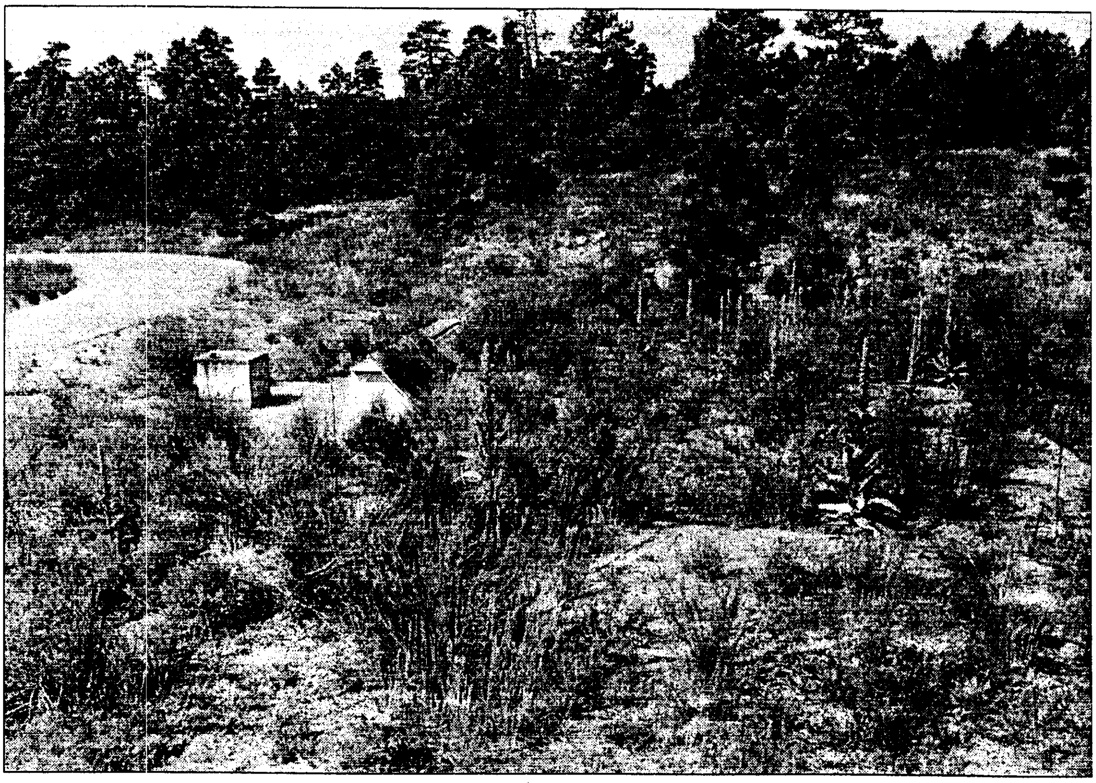

Figure 6.3-3 Firing Site R-45 looking west (photo taken July 1992).

6.3.2 Potential Source Terms

No estimates of uranium, beryllium, and lead have been made for R-45, and characterization levels will be needed at D&D. The quantities of metals are low in comparison to other firing sites.

6.4 Firing Site R-44 SWMUs 15-006(c) and 15-009(c)

6.4.1 Site Description

The third most extensively used firing site at TA-15 is known as R-44, named after the control room at this site (Figure 6.3-1). This firing site was built in 1951 and was used extensively from 1956 through 1978 for diagnostic tests of weapon components. Since PHERMEX and Ector were put into operation, this site has been used for small experiments, the last time being September 1992. The diagnostic capabilities at R-44 are different from and extremely modest compared with those at PHERMEX and Ector. The septic system at SWMU 15-009(c) is included in Firing Site R-44.

The firing site SWMU 15-006(c) is located on a relatively open flat area on a very narrow mesa jutting over Three-Mile Canyon. Consequently, some debris from the explosions has been scattered through the air into the canyon on either side of the firing site. In addition, a shelf of soil and debris [SWMU 15-008(b)] was made on the north side of the firing site when remnants and debris from tests were pushed into this area. A sampling plan for SWMU 15-008(b) is given in Chapter 9.

6.4.2 Potential Source Terms

From 1953 to 1978 approximately 7000 kg of uranium (largely DU), 350 kg beryllium, and only 15 kg of lead (Rasmussen 1992, 10-0005) have been expended on Firing Site R-44. The sampling data as explained below (DOE 1989, 0271) for the site, however, show concentrations of lead and uranium higher than those for beryllium by factors of approximately 30 and 50 respectfully.

The aerial radiological survey (Fritzsche 1989, 10-0033) can be used to estimate that in 1982 the amount of uranium in the soil at Firing Site R-44 was approximately 0.04 of the amount of uranium on Firing Site E-F, or approximately 2300 kg.

The land based radiological survey of 1991 (Schlapper 1991, 10-0009) found small pieces of uranium on the R-44 firing site area. Measured exposure rates ranged from 50 mR/h (again due to lumps of DU) on contact to as low as 0.1 mR/h (background values). The area was partially cleaned up and large chunks of uranium were removed.

A more extensive sampling effort was undertaken in the Idaho National Engineering Laboratory (INEL) Environmental Survey of 1987 (DOE 1989, 0271). Samples were taken at four radii from the center of the firing site (10, 100, 250, and 450 ft). None of the samples contained detectable quantities of HEs. Lead, beryllium, and uranium essentially decreased with distance from the center of this firing point. Lead decreased from 513 mg/kg in the center of the test area to 12 mg/kg at the greatest radius. Beryllium decreased from 16.3

mg/kg at the center to 0.6 mg/kg at the greatest radius. Uranium-238 also decreased with distance from the center (725 to 45 mg/kg). Average soil background levels are: for lead 28.4 mg/kg, for beryllium 2.4 mg/kg, and for uranium 3.4 mg/kg (Longmire et al. 1993).

The health-based risk assessment carried out for occupational workers (Section 4.3.4 and Appendix F) indicates that the concentrations of these hazardous materials are far below levels of concern for occupational workers. Characterization of Firing Site R-44 can therefore be deferred until decommissioning.

6.5 SWMUs 15-006(b) and 15-009(h); Firing Site Ector

6.5.1 Site Description

Ector is located at the junction of the road to TA-36 and the road extending north to Firing Sites R-44 and R-45 (Figure 6.3-1). In a manner similar to most new firing sites, the control room is protected by being underground rather than separated by distance from the explosion.

Ector will be evaluated more comprehensively after the migratory contaminant studies discussed in Section 6.1 have been completed.

6.5.2 Potential Source Terms

Ector has been used from the mid-1980s to the present time for dynamic radiography of explosion-driven weapons components in a manner similar to PHERMEX. However, it has not been used as extensively as PHERMEX so the potential for significant contamination by uranium, beryllium, and lead is much less than that for the PHERMEX site. For example, the beryllium expended at Ector is believed to be less than 10 kg (Rasmussen 1992, 10-0005).

Prior to the Ector installation and building TA-15-306 construction, building TA-15-280 was the control room for the firing pad that exists today. The firing site was used periodically from 1973 to 1982. The aerial radiological survey of 1982 (Fritzsche 1989, 10-0033) (Appendix H) did not reveal any radioactivity above background at this site.

The radiological survey of 1991 (Schlapper 1991, 10-0009) reported a range of contact exposure rates from not detectable to as high as 25 mR/h at selected locations on blast shields or mats or on individual uranium pieces located on the soil.

Samples from the surface and 3-ft depth were taken at the location shown as PF-MH-15A on Figure 6.3-1 for the Sanitary Wastewater System Consolidation (SWSC) project (Fresquez 1991, 10-0003). The uranium varied from 8.9 mg/kg to 20.3 mg/kg. These are significantly above tuff background levels of uranium which vary between 2.9 and 10.1 mg/kg (Longmire et al. 1993). All other hazardous constituents of interest, such as TCLP metals, RCRA target semivolatile organic compounds SVOCs, beryllium, HE residues, were at background or below detection limits.

Since the septic system at SWMU 15-009(h) is still active, and presents no current risk to users.

Because of these results, and the lack of current risk to users, we recommend the Ector site for characterization when the firing site is turned over for D&D.

6.6 Building Debris South of Building TA-15-22 SWMU 15-008(d)

6.6.1 Site Description

This building TA-15-22 is located northwest of The Hollow on an access road off the main road approaching R-40 (see map Appendix A). It was first constructed in the 1970s as a control center for the experimental accelerator in building 203 in The Hollow. This accelerator was a small prototype for the accelerator that became PHERMEX. It was anticipated that there would be a sizable beam from the experimental accelerator, which would need a remote control center and which was connected by aboveground cables (see Appendix A), placing it in the area associated with R-40. However, the beam was never used at maximum power so TA-15-22 was never used.

6.6.2 Potential Source Terms

Activities involving hazardous materials, such as the machining of HEs, were not carried out at TA-15-22. No building debris was present in 1992 near building TA-15-22. The building and surroundings will be surveyed for HEs and uranium according to the standard operating procedures (SOPs) for D&D of the buildings at TA-15 when building TA-15-22 is decommissioned. Building TA-15-22 is a candidate for the Laboratory's D&D projects beyond 1998 (Booth 1992, 10-0036).

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

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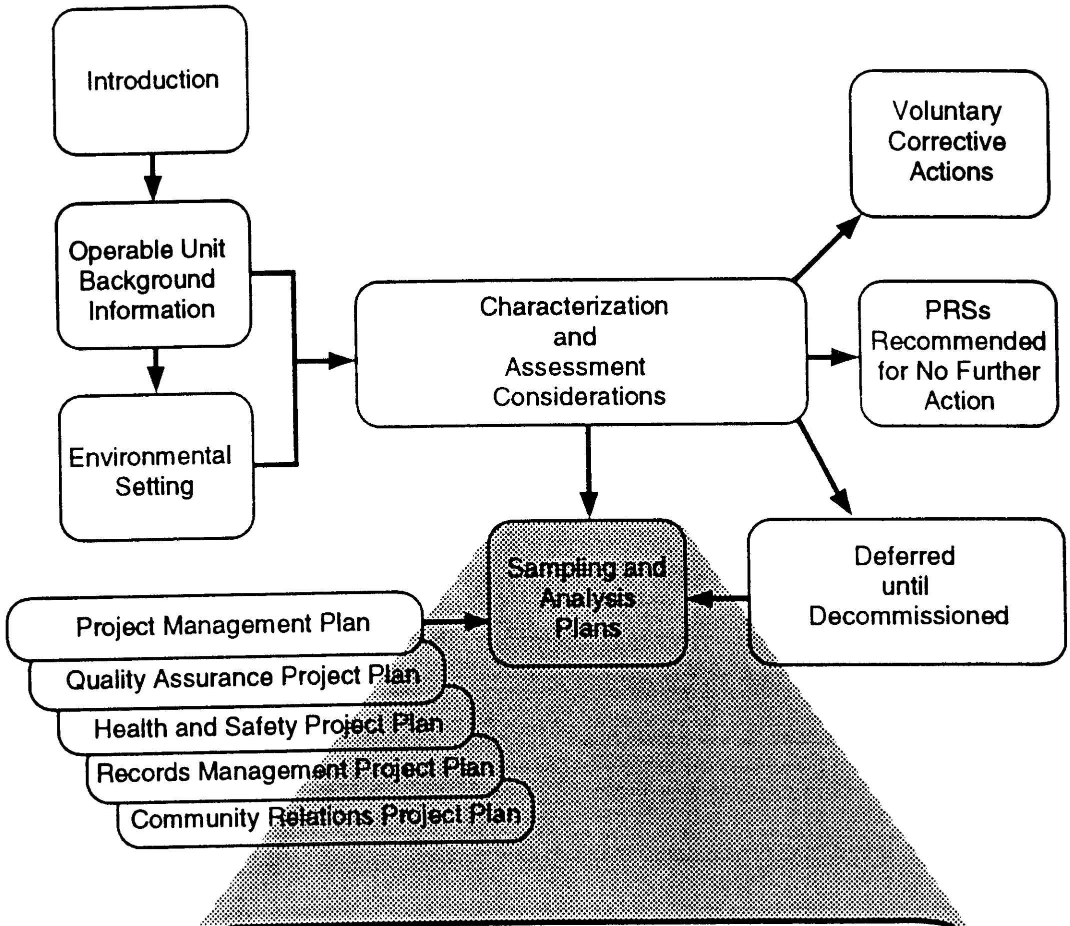
Schlapper, G., August 14, 1991. "GMX-11's Explosive Dispersal of U, Be, and Pb (Via Weapon-Related Testing, Through March 1971),"Los Alamos National Laboratory Memorandum, HS-1-91:OHP-22 to Frank Jackson (M-DO- from Gerald Schlapper (HS-1), Los Alamos, New Mexico. (Schlapper 1991. 10-009)

Venable, D., April 3, 1990. "GMX-11's Explosive Dispersal of U, Be, and Pb (Via Weapon-Related Testing, through March 1971)," Los Alamos National Laboratory Memorandum ADNWT:90-25 to Dennis Erickson (M-DO) from Douglas Venable, Los Alamos, New Mexico. (Venable 1990, 10-0010)

CHAPTER 7



Inactive Firing Site E-F

- Sampling and Analysis Plan

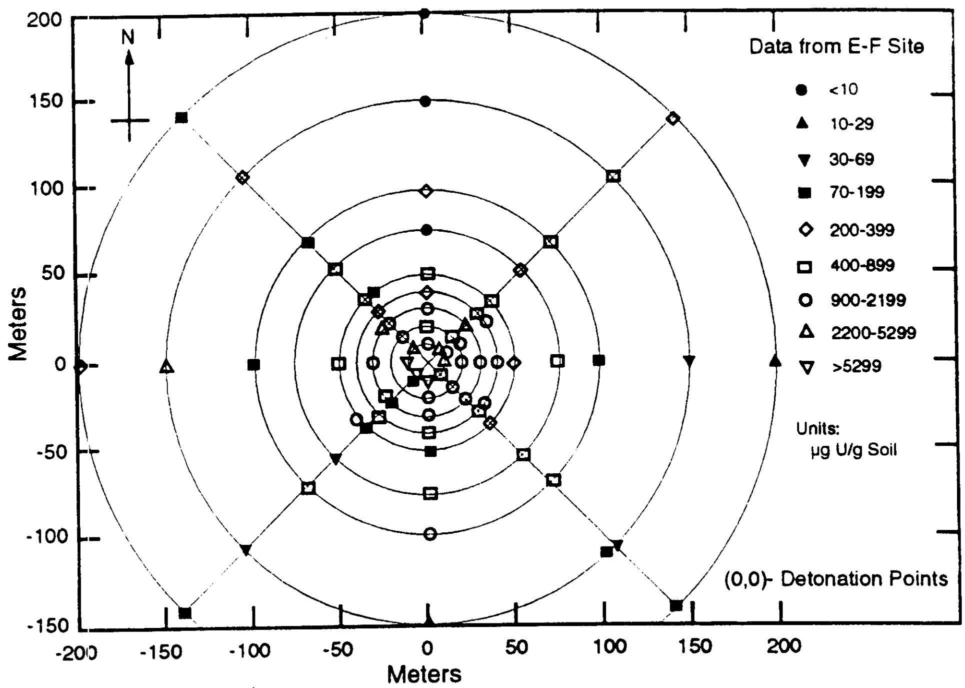


Figure 7.3-7 Polar coordinates sampling pattern used at E-F site (White, et al. 1980, 0771).

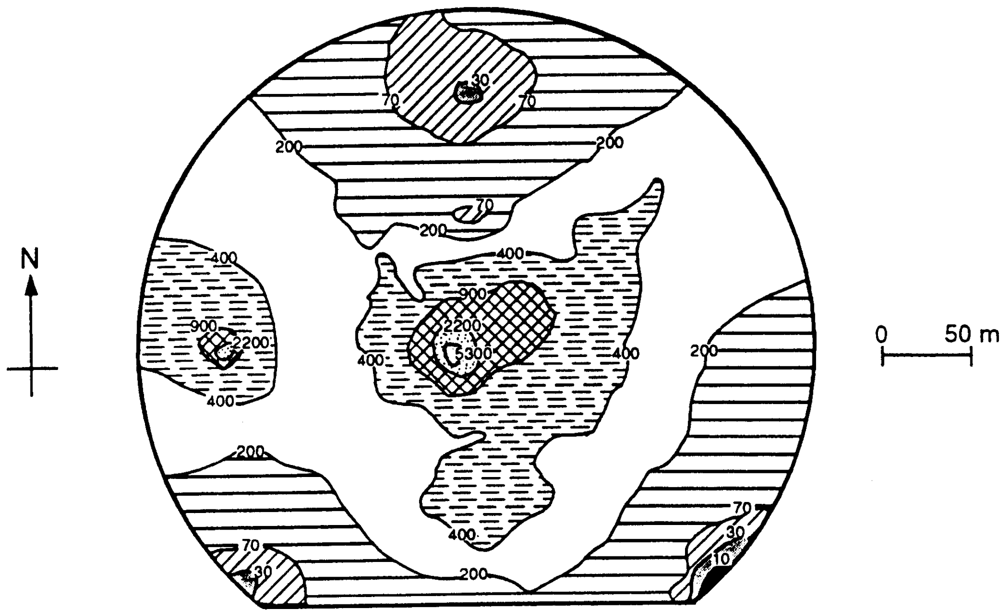


Figure 7.3-8 Contour map of uranium concentrations (µg U/g soil) at E-F site (from table 1, White, et al. 1980, 0771).

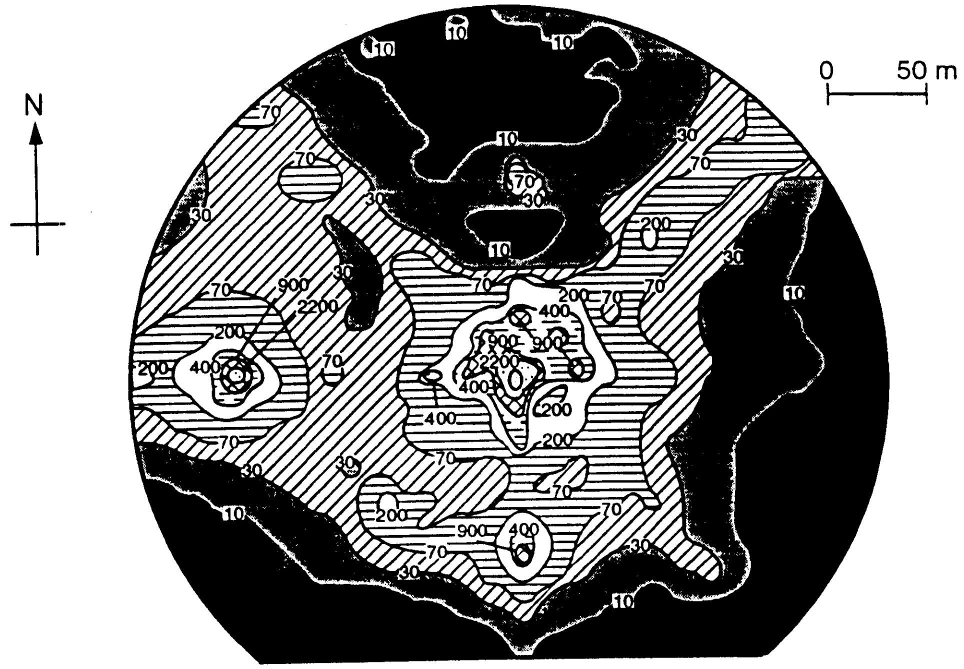


Figure 7.3-9 Contour map of the lower bound (µg U/g soil) of the kriged surface (White et al. 1980, 0771).

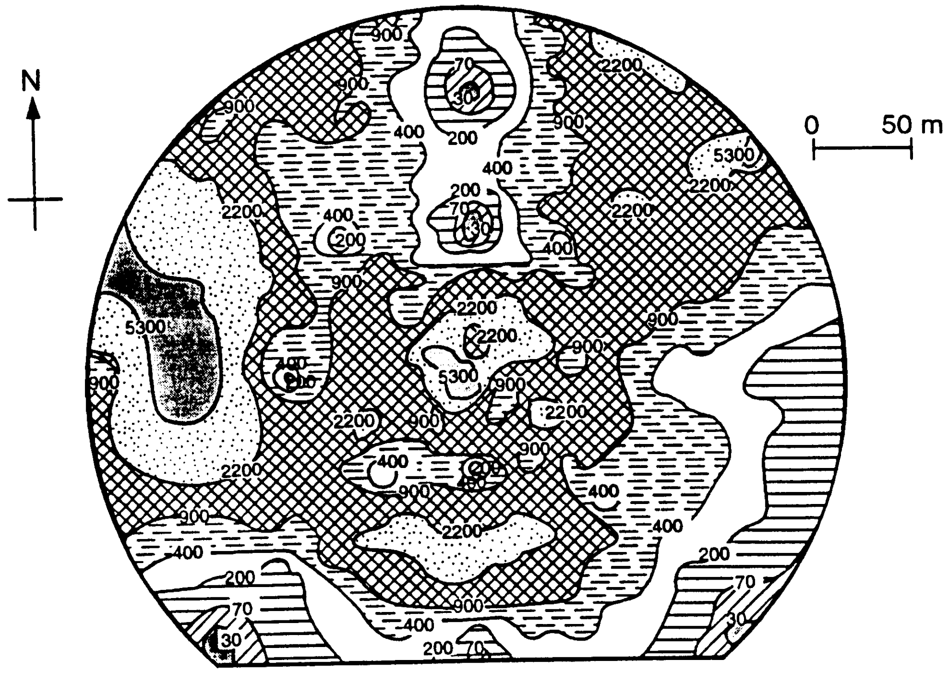


Figure 7.3-10 Contour map of the upper bound (µg U/g soil) of the kriged surface (White et al. 1980, 0771).

uranium is within 1000 ft of the firing point. Much of the uranium, especially the smaller particulates, oxidize during the explosion and upon exposure to the air after being deposited on the soil. See Table 7.3-1.

A second potentially hazardous material scattered on E-F site is beryllium, also part of some explosive devices. During the operational lifetime of E-F site, an estimated 320 kg of beryllium (Rasmussen 1992, 10-0005) were scattered by the tests along with the uranium. It is assumed that the beryllium was also partially oxidized during explosions. Because of the low soil screening action level for beryllium, beryllium may be a more significant contaminant than uranium.

Lead and mercury were used in some of the explosions at E-F site. However, the records do not provide an accurate estimate of the total amount of these two materials expended. Rasmussen (1992, 10-0011) reports that approximately 100 kg of metallic lead were used at Firing Site E-F between 1962 and 1970. Mercury was used in smaller quantities than lead but the actual amount is unknown.

High explosives and their residues, on the other hand, are not thought to be present at E-F site or at any other firing site on TA-15. Tests carried out at TA-15 firing sites have not been tests of the HEs themselves but use the HEs to drive implosions or explosions. Therefore, complete burning of the HE is expected during a test. Chemical spot tests for HEs at the firing sites of TA-15 show no evidence of unexploded HEs (DOE 1989; 0271, Hatler 1990, 10-0038). However, chemical spot tests will be repeated.

TABLE 7.3-1

AMOUNTS OF TOXIC METALS USED AT E-F SITE OVER ITS LIFETIME

	Estimated Amount at E-F Site (kg)	Screening Action Level (mg/kg)	Background Level of soil (mg/kg)*
U	63000	240	6.27
Be	320	0.16	2.37
Pb	100	500	28.36
Hg	<100	24	unknown

*Longmire et al., 1993.

7.3.5 Quantities and Locations of Potentially Hazardous Materials

Firing Point E-F has been extensively studied in the past (Hansen and Miera 1976, 0769; Miera et al. 1980, 10-0045; and Hansen and Miera 1977, 0128). Figures 7.3-7 and 7.3-8 are redrawings of the location of samples and the results of these studies. The uranium concentrations varied from over 4500 mg/kg of soil at the firing point to less than 200 mg/kg at many locations some 300 m from the firing point. The surface data are of sufficient quality to build on for Phase I studies. The subsurface data may be less well characterized.

Using these data, White et al. (1980, 0771) have determined isopleths of greatest probability for various uranium concentrations by using a method for analyzing spatial data called kriging. Kriging is a geostatistical method of developing isoconcentration contours based on field data and probabilities. These kriged surfaces are shown in contour maps in Figures 7.3-9 and 7.3-10. These isopleths are used later to develop the sampling plan proposed for E-F site.

Two points were brought out by the sample results and the isopleths.

1. Two areas of high uranium concentration are indicated, which supports the statement in Subsection 7.3.2 that the location for Firing Point D may have been some 200 m to the west of Firing Point E.
2. The isopleths at approximately 200 to 400 mg/kg are the most important in relation to the sampling plan because these represent the uranium concentration that must be further delineated based on screening action levels.

An unusual feature of this site are the large chunks of uranium that give localized high radiological readings. An early part of the sampling plans involves locating such chunks, with field radiological detectors.

Soil samples were collected up to 30 cm deep by Miera et al (1980, 10-0045). An order of magnitude decrease in uranium concentration is normally found for the top 25 to 30 cm of soil. However, the trend is far from being uniform. So that the potential for transport of uranium as uranium metal or oxide particulates and also as adsorbed to soil particulates could be evaluated (Subsection 7.3.7), Miera et al. (1980, 10-0045) determined the particle size and uranium content of soil separates. In general, an exponential decrease of uranium concentration with distance was observed for all soil sizes. There is, however, an appreciable variation in this generality as a function of both distance and depth.

Cokal and Rodgers (1985, 10-0001) measured both dissolved and suspended uranium, beryllium, and lead in ponded snowmelt at various locations during the spring. The highest dissolved uranium concentration (approximately 1.5 mg/kg) was found close to the detonation point. Dissolved beryllium and lead concentrations in the same samples were undetectable. However, suspended particulates (would not pass through a 0.4-µm filter) with beryllium concentrations up to 0.01 mg/kg and with lead concentrations as high as 0.3 mg/kg were found.

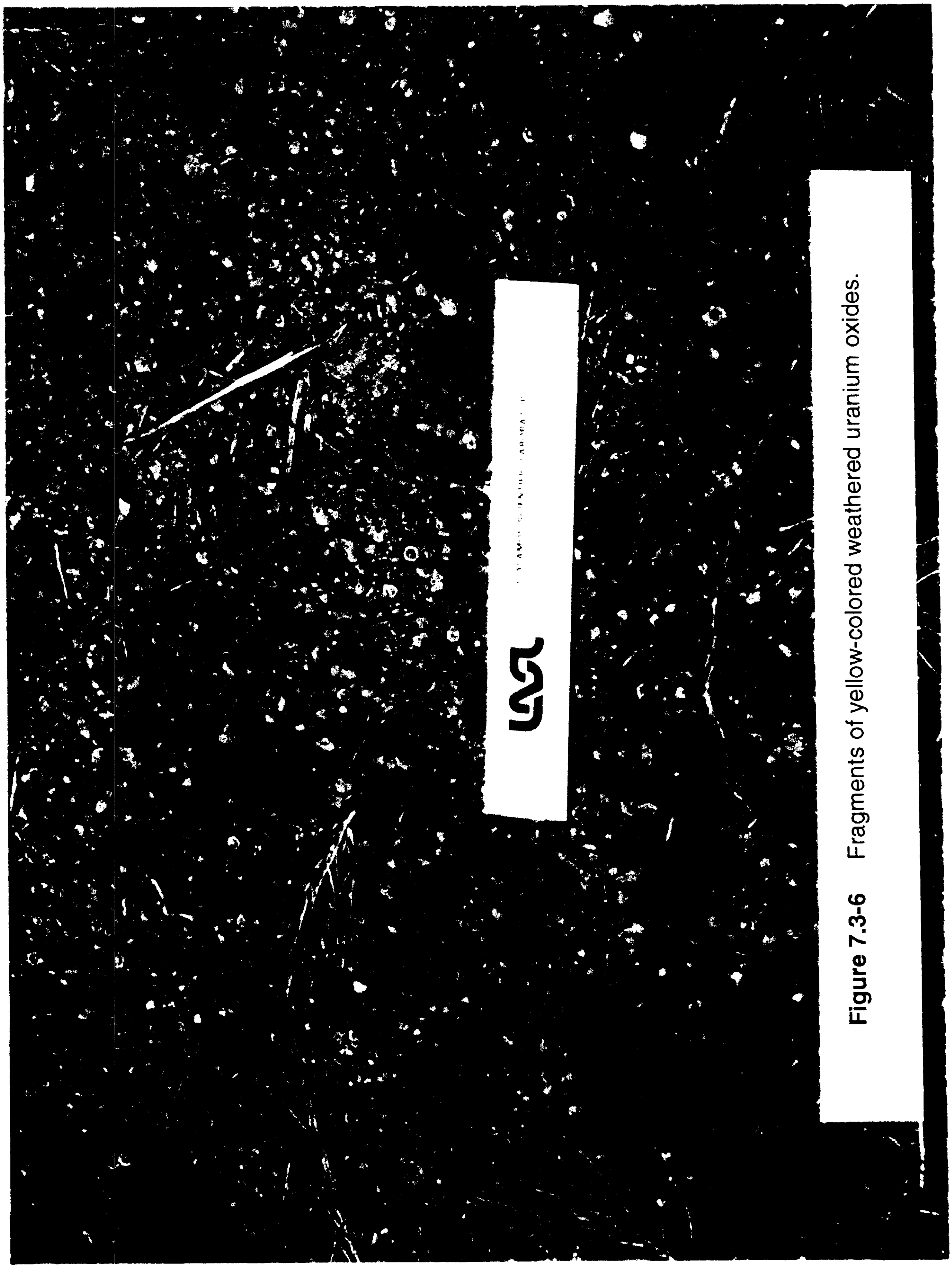


Figure 7.3-6 Fragments of yellow-colored weathered uranium oxides.

Figure 7.3-3 View to the west from top of mound at E-F site (photograph taken July 1992).

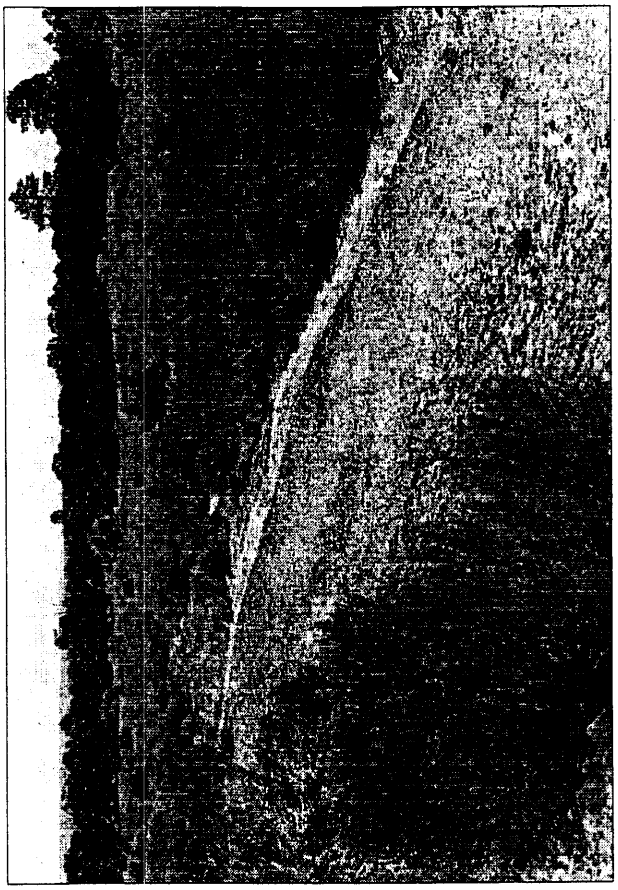


Figure 7.3-4 View to the east from top of mound at E-F site (photograph taken July 1992).

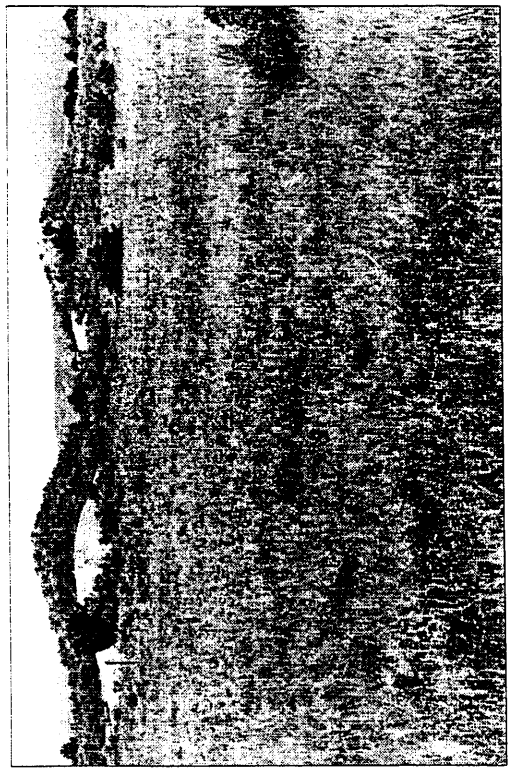


Figure 7.3-5 The mounds at E-F site, viewed from the road between R-40 and TA-36 close to the Ector turnoff (photograph taken July 1992).

Firing Points E and F were both connected to an underground, timbered, control room (TA-15-27, known as R-27) located approximately 600 ft to the southwest of Firing Point E. No information has been located relating to the amount of uranium expended at the original single Firing Point D. As will be noted later (Subsection 7.3.5), existing information indicates that the original Firing Point D may have been used for some tests. A site diagram for Firing Site E-F is shown in Figure 7.3-1.

Firing Points E and F were originally depressions in the soil. As tests were conducted, the soil was either regraded to level the disturbed earth or new gravel was brought in to fill depressions. Eventually nearby soil was mounded to the north and south of Firing Point E to protect some TA-15 site buildings. Current conditions at E-F Firing site are shown in Figures 7.3-3, 7.3-4, and 7.3-5. Explosions were carried out between the two large mounds in Figure 7.3-5. The mounds were located such that they reduced the potential for shrapnel obvious being sent in the direction of laboratory buildings, especially TA-15-40.

7.3.3 Waste Handling Practices

No major effort has been carried out to remove or remediate dispersed hazardous materials that may be present on E-F site. After each explosion, debris from the test as well as noticeable pieces of uranium metal were picked up in an effort to organize the area for the next test. On some occasions a bulldozer was used to regrade the area at the explosion (Robbins 1954, 10-0030); the rubble was added to the mounds on each side of the firing site. In other cases, gravel was brought in to fill the depressions in the ground that were made by the explosions. However, no effort was made to remediate the area of its potentially hazardous materials. Today one can still locate chunks of uranium metal scattered about, which are slowly oxidizing to yellow-colored uranium oxides, as shown in Figure 7.3-6. This gravel was bulldozed from the detonation point to these locations.

7.3.4 Potentially Hazardous Materials on E-F Site

The first main hazardous materials on E-F site probably is uranium metal and its oxidation products. The radioactivity of depleted uranium and its oxides is low compared with natural uranium ores because most of the decay-chain products were removed in the mining, milling, and metal manufacturing process. The uranium on E-F site may be of concern because of its heavy metal toxicity (which may be more meaningful than the radiological hazard) and because significant quantities are present on the surface and near-surface of the ground. However, at these locations, it is not readily accessible to potential receptors other than site workers and local animal and plant life.

It is estimated from various records (Venable 1990, 10-0010; Rasmussen 1992, 0005) that up to 63 000 kg of uranium metal, both natural and depleted, may have been expended at E-F site over its lifetime of use. Shrapnel and/or pieces of uranium could have been scattered up to approximately 3500 ft from Firing Point E-F during very large explosions, but the main area containing the

LETTER LABEL	Pa-234m COUNT RATES ABOVE BACKGROUND[1] (cps)	Pa-234m CONCENTRATION[2] (μCi/m²)
A	0 - 1125	0 - 14.0
B	1125 - 1500	14.0 - 18.6
C	1500 - 1875	18.6 - 23.3
D	1875 - 2250	23.3 - 27.9
E	2250 - 2788	27.9 - 34.6
F	2788 - 3984	34.6 - 49.4
G	3984 - 5976	49.4 - 74.1
H	5976 - 7968	74.1 - 98.8
I	7968 - 9960	98.8 - 123.5
J	9960 - 11960	123.5 - 148.3

Figure 7.3-2 Aerial radiological survey (photograph from EG&G no. 85I-479L, July 1982).

analytes are above background. Note that a statistically based sampling strategy (discussed in Chapter 4) was used to define sampling needs at some of the sites.

Of the three related potential release sites (PRSs) associated with SWMU 15-004(f) [15-008(a), 15-009(e), and C-15-004], only 15-008(a) has been incorporated into the main E-F sampling plan because it is an area where debris from E-F site has been placed; 15-009(e) and C-15-004 have separate small sampling plans related to their specific needs, which are addressed after SWMU 15-004(f).

7.3 Firing Site E-F; SWMU 15-004(f)

7.3.1 Introduction

Firing Site E-F, located on TA-15, has been the most extensively used firing site at the Laboratory, both in terms of continuing length of use and quantities of uranium expended. E-F site was established in 1947 for tests using up to 2500 lb of explosives and was used extensively through 1973. The site was last used in 1981. This is a large area; the sampling plan covers about 60 acres.

Initially, natural uranium metal was used in the devices that were tested. Between 1945 and 1957, an estimated 43 000 kg was expended on E-F site. After 1957, approximately 20 000 kg of depleted uranium (DU) was expended (Venable 1990, 10-0010) The principal effects on the ecosystem of the uranium particulates spread over the area of a firing site arise from the radioactivity of the uranium, thorium, and some protactinium isotopes and not from the radioactivity of the radon isotopes. The radon isotopes are mainly removed during the milling and refining of uranium. These effects result in a much lower specific activity than would be encountered in uranium ores.

In 1982 the Laboratory was surveyed by EG&G-Energy Measurements with radiological detectors mounted in a helicopter (Fritzsche 1989, 10-0033). The main gamma rays detected from the soils of TA-15 were the 765 and 1000 keV gamma rays attributable to Pa-234m, a daughter product in the decay chain of U-238. Results of this effort specific to TA-15 are shown in Figure 7.3-2. Three areas on TA-15 with concentrations of Pa-234 above background were observed. If one compares this figure with the topographic map in Appendix A, the areas of increased activities of Pa-234m can be defined as E-F site, PHERMEX site, and TA-15-44 site. No other firing sites in TA-15, active or inactive, exhibited Pa-234m in excess of detection limits for this method of analysis. This supports the focus on E-F site, which has the greatest contamination.

7.3.2 Background and History

Portions of TA-15 (R-site) were used for explosive testing as early as 1943 (LASL 1944, 10-0044). It was decided in 1946 (LASL 1947, 0461) that a large firing site be located on R-Site and that R-site, be made into a permanent firing site for the Laboratory. E-F site originally may have been a single Firing Point D (ENG-C15200, 1944, 10-0019), which in 1947 was expanded into a large Firing Point E (Figure 7.3-1) and a smaller Firing Point F.

7.0 SAMPLING AND ANALYSIS PLAN FOR INACTIVE FIRING SITE E-F, SWMU 15-004(f) AND RELATED POTENTIAL RELEASE SITES

A number of firing sites, located at TA-15, were in use from the establishment of this Technical Area (TA)-15 in 1945 until 1972. These sites have been inactive since that time and some have been decommissioned.

This chapter provides the description, data needs and objectives, and sampling plan for Solid Waste Management Unit (SWMU) 15-004(f) and related SWMUs 15-008(a) and 15-009(e) and Area of Concern (AOC) C-15-004. Although there are several inactive firing sites, we have chosen to address E-F site first (Figure 7.3-1) and separately from the other firing sites because of its unique features. These unique features include very large detonations, the longest used, currently inactive, firing site, the highest level of radioactive contamination at TA-15, the largest amount of quantitative scientific data assembled, and the largest area (about 60 acres).

7.1 Introduction

The overall goal of the field investigation for SWMU 15-004(f) and the other sites addressed in this chapter during the first phase of RCRA Facility Investigation (RFI) is to make a determination, based on realistic future land uses, of the presence or absence of contaminants in the soils and subsurface relative to the levels that could threaten human health and the environment. Conceptual models for potential exposure to receptors by hazardous materials in these SWMUs, including potential exposure routes, pathways, and receptors, have been identified in Chapter 4 of this Operable Unit (OU) 1086 work plan. The principal potential migration pathways for these SWMUs are aerial resuspension and erosion by surface run-off. Both of these pathways are being addressed by an ongoing study on aerial resuspension and a future study of surface run-off that is being planned for the next fiscal year. These results in conjunction with results from this sampling and analysis plan, will be available for evaluation. (see Chapter 6)

7.2 Data Needs and Objectives and Investigation Rationale

The overall objective of the sampling and analysis plan is to determine the nature and extent of the contamination, specifically the surface and subsurface radial extent of the contamination from the firing point.

Since uranium, beryllium, and lead contaminants represent by far the most significant contamination at E-F site, they are the primary focus of SWMU-specific investigations. Other contaminants are known or suspected to exist at TA-15 only in very limited quantities and generally will be associated with the aforementioned contaminants. Spot tests for high explosives (HEs)will be performed. Thus, sampling plans will take these factors into account to maximize the effectiveness of the RFI by focusing on a set of TA-15 indicator analytes. The field investigation logic assumes that potential contaminants of concern (COCs) will first be surveyed for and detected by radiological and other analytical methods performed in the field, followed by discrete sampling and analysis for a limited set (20%) of indicator analytes, where the indicator

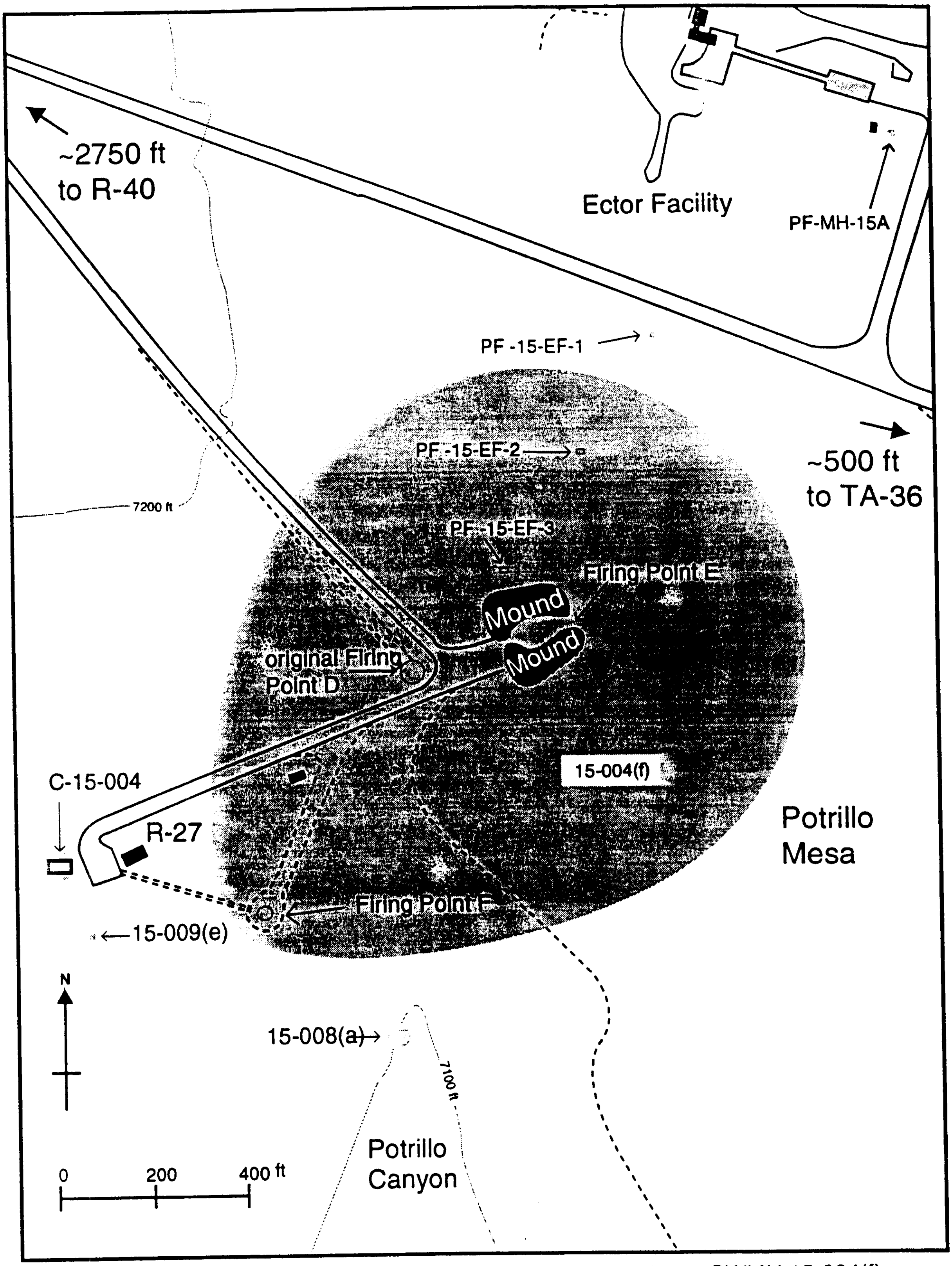


Figure 7.3-1 Site diagram for Firing Site E-F; shaded area shows SWMU 15-004(f).

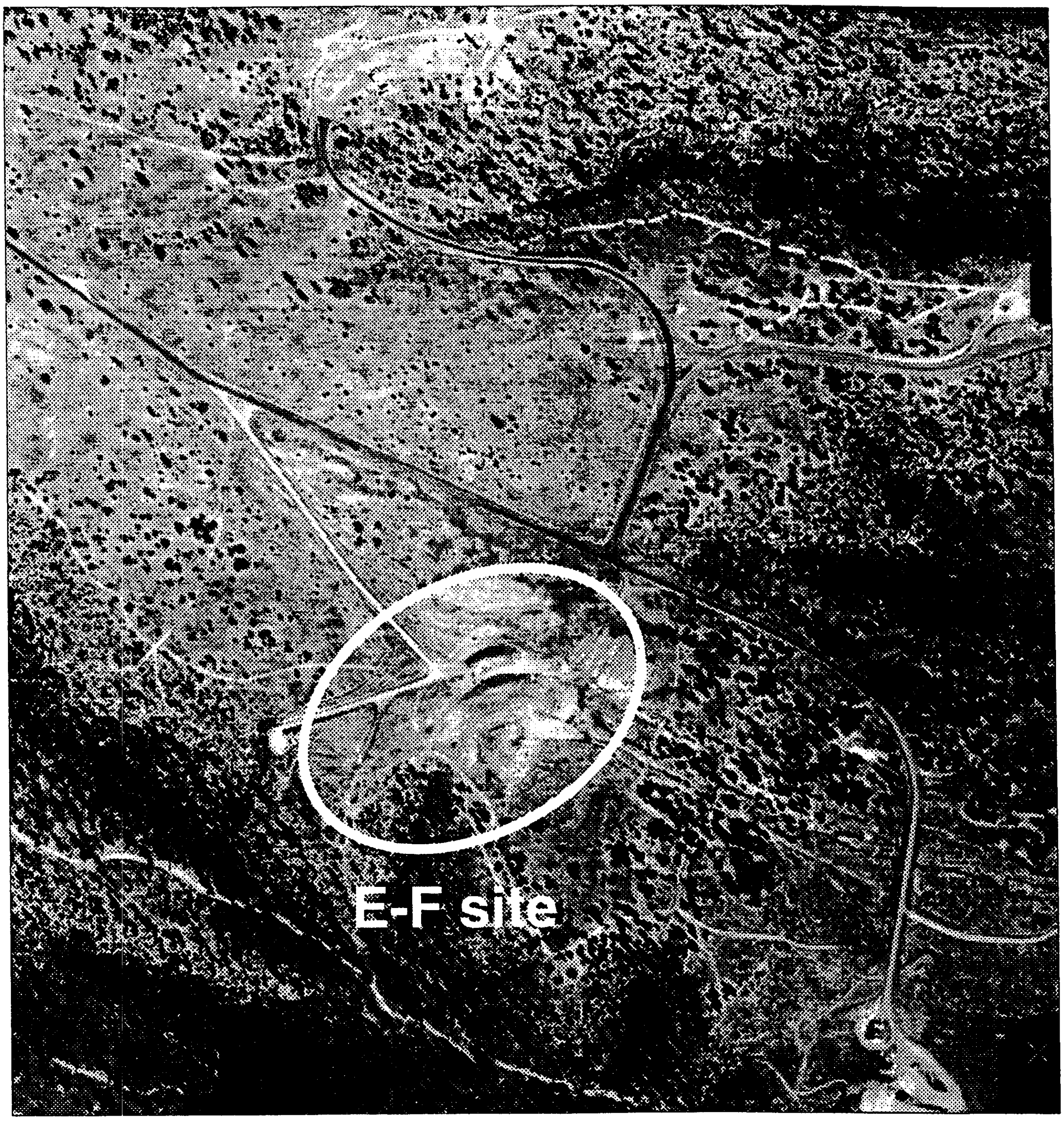


Figure 7.3-11 Aerial photograph taken in 1974 of E-F site.

7.3.6 Potential Pathways

Technical Area 15 presently is isolated by a substantial distance from potential receptors, other than occupational workers. The closest human residential receptors are at Los Alamos townsite by the pathway of airborne resuspension (Section 4.2.2) and in White Rock by the pathway of storm-driven water run-off into Potrillo Canyon as well as by airborne resuspension. Animals and plants are also receptors.

7.3.7 Uranium Concentration along Potential Pathways

Firing Site E-F is located approximately in the center of a large, relatively flat area of Three-Mile Mesa (Figure EXEC-3). The main water run-off is southward to Potrillo Canyon. A minor run-off pathway is northeastward to a small tributary of Three-Mile Canyon, which empties into Pajarito Canyon. Both Potrillo and Pajarito canyons empty into the Rio Grande near White Rock. As noted in Section 3.5, these canyons do not experience perennial surface water flow. Figure 7.3-11 shows an aerial photograph of taken in 1974 of E-F site .

Samples were collected by Miera et al. (1980, 10-0045) beginning at the E-F firing point and extending along the main drainage pathway from the mesa top southward into Potrillo Canyon. Samples were not taken along the minor drainage pathway northeast into Three-Mile Canyon tributary. In general, concentrations of uranium were found to decrease with distance away from the detonation point and also to decrease with depth in the soil. Beyond 1400 m from the detonation point and within Potrillo Canyon, the concentration of uranium in the samples continued to decrease with levels not too different from background values for uranium in tuff. These results suggest significant uranium sources still remain on the the mesa top.

Two mechanisms by which uranium has been and may currently be transported from the firing sites on mesa tops to the canyons are:

1. Surface water run-off carries both dissolved uranium (up to 0.65 µg/ml) and suspended particulates of uranium (up to 400 µg/ml) from the firing sites on the mesa tops. The quantity of uranium associated with the particulates is much greater than that which is dissolved (Becker 1991, 0699), and
2. Explosive-driven particulates are scattered over large areas by large tests.

Both mechanisms are subject to ongoing studies, see chapter 6.

7.3.8 Data Needs

The following data are needed for E-F site:

1. The surficial extent of uranium concentrations greater than the 240 µg/g determined by the screening action level (IWP - 1992, 0768) as the level of concern for Phase I investigations,
2. Depth to which the uranium exceeds the concentration of 240 µg/g,

3. Surface and depth in which beryllium and lead exceed the concentrations of 0.16 and 500 µg/g, respectively, given by the defined screening action level,
4. The presence or absence of undocumented mercury and other metals; the screening action level for mercury is 24 mg/kg,
5. The presence or absence of residual HEs,
6. Rate of transport of particulates from E-F site to the canyon drainages, and the rate of transport along the canyon drainages, and
7. Rate of resuspension of contaminated particulates into the air due to present day activities and climatic conditions.

7.3.9 Sampling Plan

The sampling plan is divided into the following sections:

- Site land survey
- Radiological ground survey for
  - Identification of large chunks of uranium metal and oxides
  - Site survey lateral extent of uranium
- Chemical site screening survey
- Sampling for residual high explosives
- Lateral extent of uranium in natural terrain
- Vertical extent of uranium, beryllium, and lead in natural terrain
- Vertical extent of uranium, beryllium, and lead on man-disturbed terrain

The results from any part of the sampling plan may modify the rest of the sampling plan if unforeseen results are obtained. An outline of the sampling plan for E-F site is presented in Table 7.3-2, (at end of chapter) which also addresses the other potential release sites (PRSs) associated with E-F site. Table 7.3-3 presents the sampling and analysis plan and is given in Appendix I.

7.3.9.1. Site Land Survey

If the positions of samples are to be accurately identified, the site must first be surveyed and the sampling grid established. A 200-ft grid has been determined to be necessary (see chapter 4, section 4). Figure 7.3-12 shows the grid location. The grid extends a 1000 ft in all directions from the firing point. Surveyors will survey the grid and mark the grid points.

TABLE 7.3-2

OUTLINE OF SAMPLING PLAN FOR EF SITE
TOTAL AREA 60 ACRES

	TOTAL SAMPLES	% USED	FIELD SCREENING: Number	Alpha Beta Gamma	Uranium	Lead	Mercury	HE	PCB	VOC	LABORATORY ANALYSES: Number (20%)	Gamma	Uranium	Beryllium	Lead	Mercury	HE	PCB	VOC	SVOC
A. SWMU 14-004(f)																				
1. Site Survey																				
2.. Radiological Survey (lateral extent of U)				X																
3 . Sampling for residual HE	70	50	35					X			TBD after field screening									
4. Lateral extent U, Be, Pb	70	100	70	X		X					14	X	X	X	X					
5. Vertical extent U, Be, Pb (undisturbed, at 6" and 2')	29	100	29	X		X					6	X	X	X	X					
6. Vertical extent U, Be, Pb (disturbed, at 6", and at tuff)	6	100	6	X		X					1	X	X	X	X					
7. Sampling for Hg	105	50	53				X				TBD after field screening. If necessary will be performed with U, Be, and Pb									
B. SWMU 15-008(a) debris	3	100	3	X		X	X	X			100% 3	X	X	X	X		X			
C. AOC 15-004 transformer station	2	100	2						X		2							X		
D. SWMU 15-009 (e)	2	100	2	X		X	X	X		X	2	X	X	X	X		X		X	X

NOTE: Lateral extent sampling includes collection of 59 samples at Firing Site E-F, 2 samples at Firing Point D, 3 Samples at Firing Point F, 3 samples in the drainageway to Potrillo Canyon and 3 samples in the drainageway to the northeast.

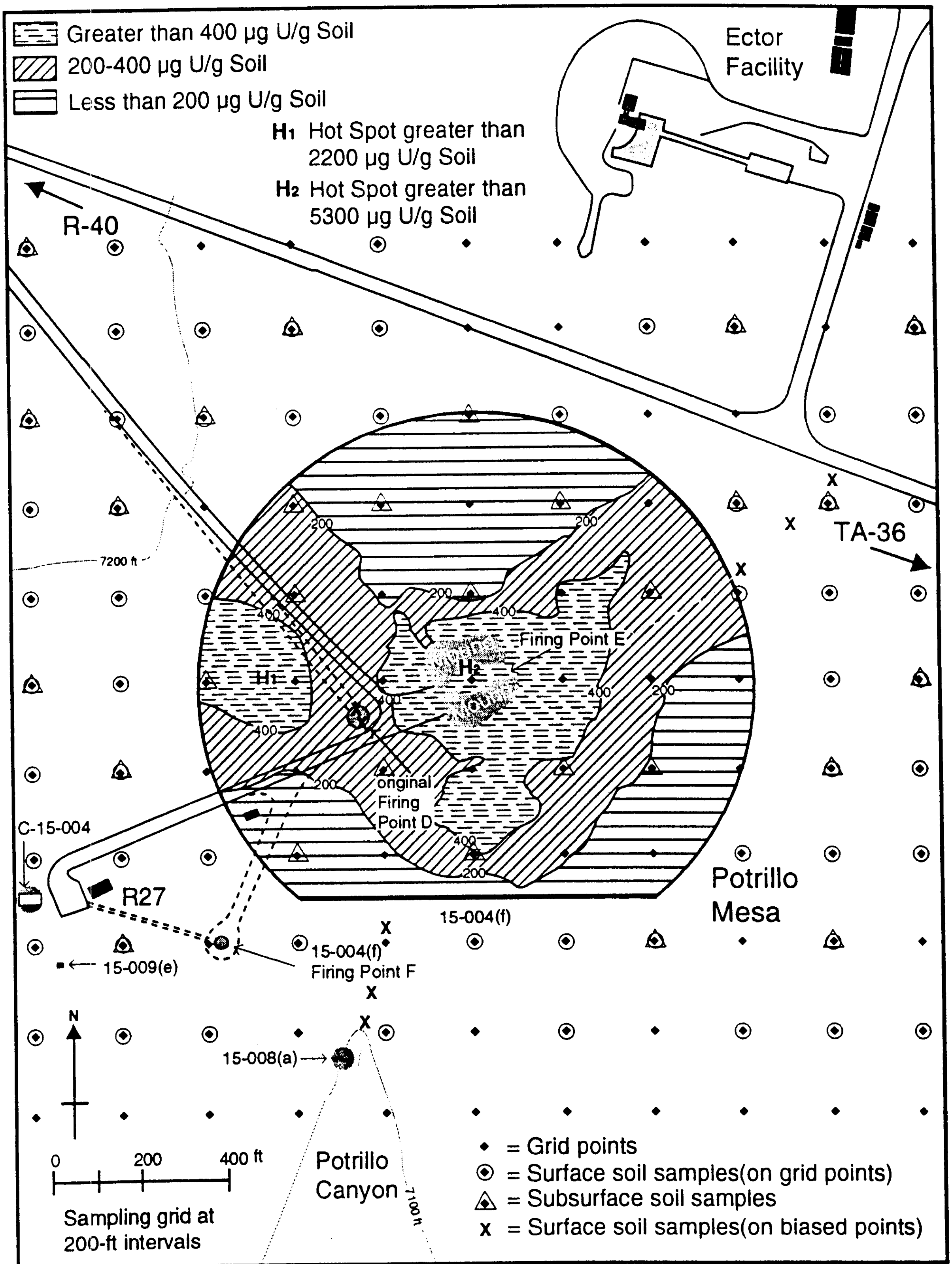


Figure 7.3-12 Site diagram for Firing Site E-F with sampling plan. The contour map of uranium concentrations is taken from Table I (White et al. 1980, 0771).

7.3.9.2 Radiological Ground Survey

Large chunks of uranium metal and oxides provide anomalously high values of radiological contamination over the average of the entire area and bias the statistical studies. Radiological screening with land-based gamma or X-ray detectors (Appendix G) or equivalent instrumentation will be performed extensively to

1. Identify large chunks of uranium metal and oxides, and to
2. Determine the lateral extent of uranium in terrain.

7.3.9.3 Chemical Site Screening

Using the same grid set up for the radiological survey, field screening will be carried out for uranium, lead and mercury using X-ray fluorescence or an alternate method. Beryllium field screening will be conducted using laser-induced breakdown spectroscopy.

7.3.9.4 Sampling for Residual HE

No HE contamination has ever been found even though tested for on numerous occasions. We propose to carry out field tests over 50% of the sampling points shown in Figure 7.3-12. If any of these spot field tests are positive, samples will be sent out for analytical screening.

7.3.9.5 Lateral Extent of Uranium Beryllium and Lead

Estimates will be made from the results of chemical site screening (Section 7.3.9.3.). Samples (20%) will then be sent for lab. analysis.

Figure 7.3-12 exhibits a 200-ft grid superimposed on Figure 7.3-8, the isopleths of experimentally determined uranium concentrations. In addition to the regular grid, locations will be marked at 100-ft intervals along the estimated midpoints of the south drainage and the northeast drainage.

The Phase I investigation of the lateral extent of spread of uranium, beryllium, and lead will extend outward from the areas already sampled in earlier investigations (see Figure 7.3-12). As stated in Subsection 7.3.4, shrapnel and/or pieces of uranium could have been scattered approximately 3500 ft from the detonation point, although the main area of uranium is expected to lie within 1000 ft of the firing point. Sampling will be performed out to a distance of 1000 ft during the Phase I investigation or until natural barriers (such as canyon walls) are reached. Since the blasts are expected to have dispersed materials more or less equally in all directions, surface soil samples will be collected in a grid configuration encircling the site. The number of samples to be collected is 59. This number, which corresponds to a 95% confidence interval, was selected because the total area that is likely to be contaminated is judged to be no more than 5% of the total area extending outward from the already characterized area to a distance of 1000 ft from the firing point. Chapter 4 provides an explanation of how the number of samples is correlated to the confidence interval.

As adjuncts to the main grid, there are sampling plans for the mounds, Firing Point D, Firing Point F, and the main water run-offs from the mesa top, as shown in Figure 7.3-12. The sampling strategy for the mounds is presented in Subsection 7.3.9.7.

There will be only sub-surface sampling at the mounds near Firing Point E because the grading and moving of the soil has been so extensive means the quality of the soil will be fairly uniform.

Sampling of original Firing Point D entails collection of two surface soil samples at random locations within the boundaries of the SWMU. A small number of samples was chosen for Phase I investigation of Firing Point D because the firing site is known to occur within the 200-400 mg/kg uranium isopleth shown in Figure 7.3-12. Two samples are appropriate for samples of sites in which 70%-80% of the area is suspected of being contaminated. The large area of suspected contamination was judged to be appropriate when sampling within proximity of the point of firing of explosive devices was considered.

Firing Point F lies outside of the characterized area shown in Figure 7.3-12. Thus, the presence of contamination at Firing Point F has not been assessed. For purposes of the Phase I investigation, it was decided that at least 60% of the area within a 100-ft radius of the firing point contains uranium, beryllium, and lead. To achieve a 95% confidence level that contamination will not be overlooked, three samples will be collected within a 100-ft radius of the firing point. The sample locations will be biased, with one being located at the firing point, another 50 ft from the firing point, and the third 100 ft from the firing point. The direction of sample location from the firing point should not be a factor in sample placement because the explosions are expected to have dispersed particles uniformly in all directions. These samples are not shown in Figure 7.3-12.

The two surface drainages, one directed south and disappearing into Potrillo Canyon and the other draining to the northeast of E-F site, will be sampled. Because they drain contaminated areas within E-F site (Figure 7.3-12), it is likely that at least 50% of the area within the drainage channels contains the same materials as those to be sampled at site E-F. Therefore, three samples will be collected in each of the two drainage systems. The sample locations will be biased to points within the drainage ways that contain collected sediments. A 50-ft distance minimum will be maintained between sampling points. All sample locations will be outside of the characterized area shown in Figure 7.3-12.

7.3.9.6 Vertical Extent of Uranium, Beryllium, and Lead in Natural Terrain

The extent of uranium, beryllium, and lead at depth cannot be determined at depth unless samples are physically taken by digging. The same grid locations that were surveyed for surface screening are to be used for depth samples.

Core samples will be taken in plastic-lined barrels at each location to 2 ft in depth. Each core, beginning with cores farthest from the detonation point, will be field-laboratory surveyed both radiologically and chemically to determine the contaminants in any 6-in. portions of the cores.

The sampling strategy to determine the vertical extent of uranium, beryllium, and lead consists of placement of borings to a 2-ft depth at points within the characterized area and at points surrounding the characterized area. The outermost sampling points will be located no more than 1000 ft from the firing point. Although there has been a certain amount of subsurface sampling within the characterized area, the degree of characterization of the subsurface soil was not as complete as the surface characterization. The decision to extend the Phase I subsurface investigation into the characterized area is based on lack of confidence that the subsurface soil has been adequately examined to a depth of 2 ft (the approximate depth to tuff). A "driven-casing" system may be used to obtain cores, if necessary—digging may be sufficient.

The number of subsurface samples to be collected was determined by judgment of the amount of area that might be contaminated within the total area to be sampled. Although contamination could be expected to be present in most, if not all, of the area immediately surrounding the firing site, the contaminated area is known to decrease dramatically as the distance from the firing point increases. Because the characterized area is included in the subsurface sampling investigation, the total contaminated area is expected to be higher than that estimated (5%) for the surface investigation. A judgment of 10% total contamination of the subsurface soils was made. To achieve a 95% probability that the subsurface investigation would result in detection of subsurface contamination if it were truly present, a minimum of 29 samples are required. These 29 samples are split between 6 in. and 24 in. ie. 15 at 6 in. and 14 at 24 in.

The locations of the subsurface sampling points are shown in Figure 7.3-12. Field screening will be performed for all of the samples collected, and a percentage sent for laboratory analysis.

7.3.9.7 Vertical Extent of Uranium, Beryllium, and Lead on Man-Disturbed Terrain

During the period from 1957 to 1972 when E-F site was used extensively for testing, the soil at the detonation point was disturbed many times: gravel was added, gravel was pushed aside, large mounds of soil were added on two sides of the detonation point, and soil was scattered by the explosions. This area should be given special attention to determine the depth of the potentially hazardous materials because of all the mixing. Because contamination exists throughout the mounds, cores are to be taken at greater depths than those taken on natural undisturbed terrain.

The sampling strategy consists of placement of two borings possibly using "driven casing" systems, at the perimeter (the soil at the perimeter of the mounds is expected to contain the same substances) of each mound and the collection of one soil sample from each mound. The soil sample from each mound will be collected at a depth of 1 to 2 ft within each mound. The soil borings will extend to the tuff underlying the site. Samples will be collected 6 in. below the surface and at the soil/tuff interface.

In summary, a total of six samples (two from the mounds and four from the boreholes located at the perimeter of the mounds) will be collected during Phase I investigation of the mounds. These will all be samples at 6" and 12", and are not shown on Figure 7.3-12. Should radiological screening of the bottom section of the cores still indicate uranium concentrations greater than 240 mg/kg, the depths of the coring will be increased to a maximum of another 10 ft.

Samples will be processed and analyzed in the same manner as that of other cores; some of these samples will be sent for laboratory analyses.

7.3.9.8 Sampling for Mercury

Fifty percent of the total number of samples will undergo a chemical field screening. If no positive results for mercury are obtained, we will test no further.

However, if mercury is found, then it will be analyzed at the locations where it was found. Testing on vertically obtained samples will be carried out at the same time as uranium, beryllium, and lead.

7.4. SWMU 15-008(a); Surface Disposal

7.4.1 Site Description, History, and Potential Sources

Two small areas have been located at the canyon edge where debris from explosions at E-F site has been deposited [SWMU 15-008(a)] (shown in Figure 7.3-1 and the topographical map in Appendix A). The debris comprises metal pieces, soil, pieces of plastic, rocks and pebbles, short pieces of electrical cable, other electrical accessories, and miscellaneous debris. Undoubtedly this debris is contaminated with small amounts of uranium, beryllium, and lead. Uranium was not detected during the aerial radiological survey (Fritzsche 1989, 10-0033). The debris is a very heterogenous mixture, and each pile is perhaps a dump-truck load in volume.

If the material were left as it is, the SWMU would be an attractive nuisance and might be a higher risk to receptors, who might be inclined to dig in it or scavenge out of curiosity. Therefore, the material should not be left as it is.

7.4.2 Action Recommended

We propose to include SWMU 15-008(a) in the ground-based radiological survey of SWMU 15-004(f). Further, the run-off from E-F site passes very close to this SWMU so that sampling results will become available from past and present run-off studies. In addition, three samples for uranium, beryllium, and lead, and HE analyses will be taken near the debris. Three samples are believed to be sufficient because there is a high probability that at least 60% of the area is contaminated (much of the waste material was generated during test firings). These sample locations are not shown in Figure 7.3-12.

If the sampling results are positive, the area will be included with SWMU 14-004(f). If the results are negative, it would be cost effective simply to package and transport this material to the new Mixed Waste Storage and Disposal Area, once this facility has been licensed for mixed waste. This is a voluntary corrective action.

7.5 AOC 15-004; Transformer Station

A transformer station designated TA-15-56 was located 20 to 30 ft southwest of building TA-15-27, the control room for Firing Site E-F (Figure 7.3-1). Two transformers were located on a wooden platform some 10 ft in the air. These two transformers (30-gal. and 18-gal. capacity, respectively) contained oil contaminated with polychlorinated biphenyls (PCBs). The transformers were removed in 1989 (Francis 1992, 10-0002). These sample locations are not shown in Figure 7.3-12.

There is no evidence of leakage on the wood platform or on the soil in a small arroyo below the platform. However, two soil samples beneath the platform will be field screened and laboratory analyzed for PCBs.

7.6 SWMU 15-009(e); Active Septic System

SWMU 15-009(e) is listed with other active septic systems at TA-15 in Table10.2-5. We propose to take two samples of sludge to insure contamination has not been missed.These are not shown in Figure 7.3-12. Lab analyses will be conducted for radioactivity, HEs, volatile and semivolatile organic compounds, as listed in EPA methods 8240 and 8270 and heavy metals. If these tests are negative, we propose no further action.

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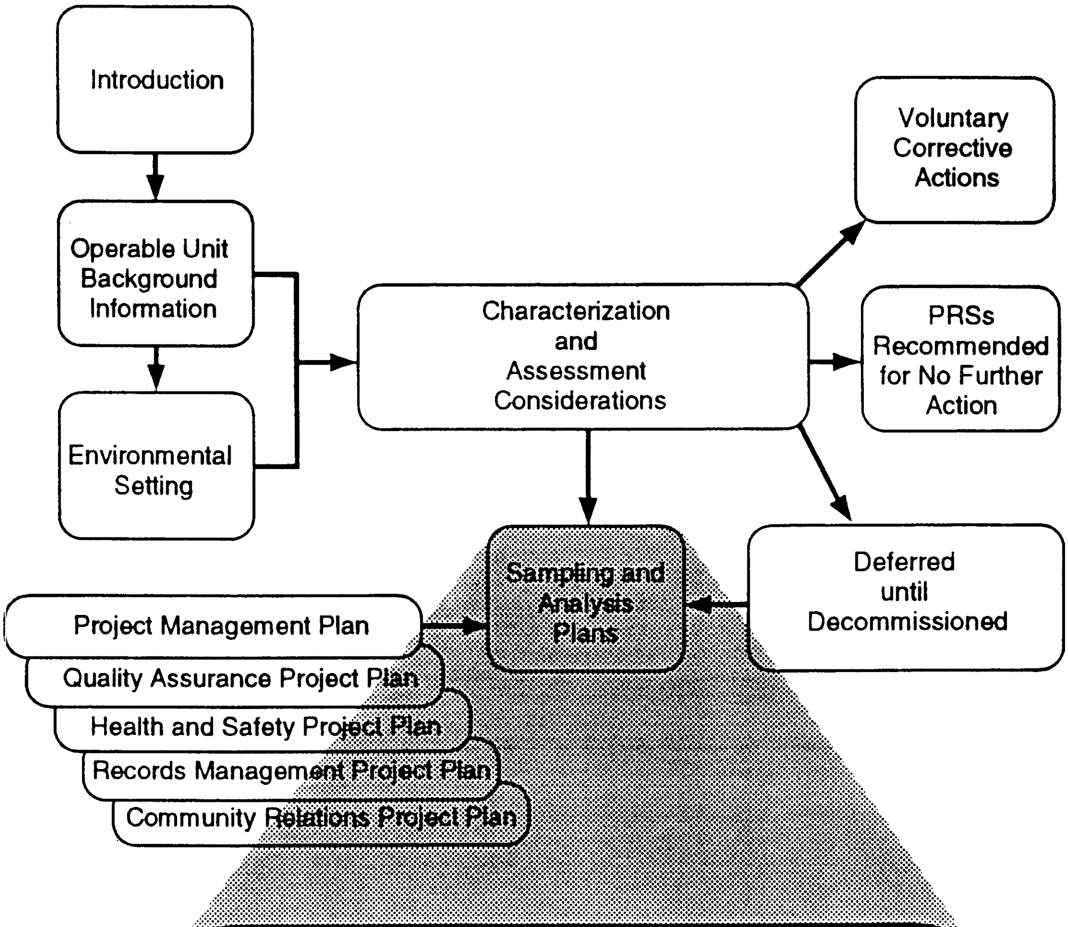
CHAPTER 8



Sampling and Analysis Plans

- Inactive Firing Sites A, B, C, G, H, Burn Pit, and Related Units

8.0 SAMPLING AND ANALYSIS PLANS FOR INACTIVE FIRING SITES AND RELATED POTENTIAL RELEASE SITES

A number of firing sites other than EF site, located at Technical Area (TA)15, were in use from the establishment of this TA-15 in 1945 until 1972. These sites have been inactive since 1972 and some have been decommissioned.

This chapter provides the description, data needs and objectives, and sampling plan for the following inactive firing sites and related units, which consist of the following potential release sites (PRSs):

Section 8.3

SWMU 15-004 (b)	Firing Site A
SWMU 15-004 (c)	Firing Site B

Section 8.4

SWMU 15-004 (a)	Firing Site C
SWMU 15-004 (d)	Firing Site C

Section 8.5

SWMU 15-004 (g)	Firing Site G
including SWMU 15-008 (c)	Surface disposal area
SWMU 15-001	Boneyard
AOC C-15-001	Soil pile
SWMU 15-009 (j)	Active septic system

Section 8.6

SWMU 15-004 (h)	Firing Site H
including SWMU 15-010 (c)	Inactive septic system
AOC-15-011	Inactive underground storage tank

Section 8.7

SWMU 15-002	Burn pit

8.1 Introduction

Sections 8.3 through 8.7 describe the objectives, the background details, and the sampling plans for the inactive smaller Firing Sites A, B, C, G, H, and an unnamed burn pit, and related PRSs.

The locations of these firing site Solid Waste Management Units (SWMUs) are shown in Figure EXEC-3 and on the maps in Figures 8.3-1 [15-004(b) and (c)], 8.4-1 [15-004(d) and (a)], 8.5-1 [15-001, 15-004(g), 15-008(c), 15-009(e) and Area of Concern (AOC) C-15-001], 8.6-2 [15-004(h), 15-010(c) and C-15-011] and 8.7-1 (15-002). These figures are given in the relevant sections.

The overall goal of the field investigation is to demonstrate and document that areas containing these PRSs are suitable for continued Laboratory use or if Laboratory institutional control of the land is relinquished and the land reverts to the US Forest Service or Bandelier National Monument (BNM) as described in Chapter 4, that the area is suitable for recreational use. The field investigation will provide the information needed to determine if remediation will be necessary before the site is suitable for recreational use.

For the inactive firing site PRSs addressed in this chapter, RCRA Facility Investigation (RFI) data are needed primarily to determine the presence or absence of contaminants in the soils and subsurface relative to the levels that could threaten human health and the environment based on realistic future land uses. Conceptual models for potential exposure to receptors by hazardous materials in these PRSs, including potential exposure routes, pathways, and receptors, have been identified in Chapter 4 of this Operable Unit (OU) 1086 work plan. The principal potential migration pathways for these SWMUs are erosion by surface run-off and aerial resuspension.

8.2 Data Needs and Objectives and Investigation Rationale

The overall objective of the studies of the PRSs discussed in this chapter is to determine the nature and extent of the contamination.

A single phase of investigation may be sufficient to determine whether concentrations of potential contaminants are greater than screening action levels (SALs). If concentrations are lower than the SAL, a negative answer at decision Point 4 (see Chapter 4) results. In this case, the RFI/CMS (Corrective Measures Study) process will cease after Phase I has been completed and no further action (NFA) will be proposed. If this expectation is not fulfilled (that is, a positive answer at Decision Point 4), Phase II investigation may be required, which could involve statistically based surface and subsurface sampling over a greater spatial extent and a more detailed analyte suite.

It is also possible that the Laboratory may consider cleaning up some of the smaller areas of contamination in voluntary corrective actions (VCAs). Examples of such cleanup would be removal of discrete large pieces of depleted uranium (DU) or of exposed scrap from a canyon edge and trucking this material to a disposal facility.

Since uranium, beryllium, and lead contaminants represent by far the most significant contamination at TA-15, they are the primary focus of SWMU-specific investigations. Other contaminants are known or suspected to exist at TA-15 only in limited quantities and generally will be associated with the aforementioned contaminants. Thus, sampling plans will take these factors into account to maximize the effectiveness of the RFI by focusing on a set of TA-15 indicator analytes. The field investigation logic assumes that TA-15 will first be field surveyed by radiological methods for potential contaminants of concern (COCs) and then will be sampled and analyzed for a limited set of indicator analytes. A vertical sampling interval of 0 to 6 in. has been judged appropriate for surface soil samples. The Quality Assurance Project Plan (QAPjP) sample requirements are summarized in Annex III.

Both radiological (alpha, beta, gamma) and chemical for uranium and lead field surveys will be conducted. At present, there is no field screening method for beryllium. If a method is developed before sampling begins, it will be utilized at all sites within OU 1086 at which beryllium is suspected to be present; laser isotope breakdown spectroscopy is the prime candidate. In addition laboratory analyses will be performed as shown in the relevant sampling plan tables. Throughout this workplan subsurface sampling is defined as being to a depth of 24 in. In reality this depth will vary from site to site depending on the soil thickness and the soil to tuff boundary.

Significant levels of high explosives (HEs) and their residues are thought to be absent at all firing sites on TA-15. Tests carried out were not tests of the HEs themselves but used the HEs to drive implosion or explosion. Therefore, complete burning of the HEs is expected during tests. Chemical spot tests for HEs at the firing sites of TA-15 showed no evidence of unexploded HEs (DOE 1989, 0271; Hatler 1990, 10-0038). However, confirmatory HE field spot tests will be repeated on 25% of the grid points samples. If any positive results are obtained, the samples that are positive will be sent out for laboratory analyses of HEs.

In most cases the Laboratory SWMU report (LANL 1990, 0145) lists two structures for each of the firing sites: normally a control chamber and a unit where connections are made from the cabling of the device to the cabling of the control room, called the x-unit. These are not individual SWMUs but are separate structures associated with the same firing site. The test explosions normally are carried out close to the x-unit.

8.3 Firing Sites A and B; SWMUs 15-004(b) and 15-004(c)

8.3.1 Site Description, History, and Potential Source Terms

Initial construction at TA-15 (R-site) was completed in 1944 (LASL 1944, 10-0044) and the site was then ready for research equipment to be installed. Among the first firing sites to be used were those known as A and B. These two small firing sites were located close together (approximately 200 ft apart) (ENG-C 12817, 1944,10-0026) on a flat area southwest of present-day building TA-15-183 (Figure 8.3-1) that had formerly been farm land. The experimental work was carried out largely at Firing Point A, where the sizes of the explosions were relatively small. Both sites were used from approximately 1945 to 1952, and both were decommissioned and the land regraded in 1967 (Figure 8.3-2). Before being decommissioned, two of the structures associated with Firing Sites A and B (TA-15-14 and TA-15-74) were surveyed and found to contain no detectable levels of either radioactive matter or HEs (Buckland 1965 10-0032; Courtright 1965, 10-0034). We believe that any contamination by hazardous materials at Firing Sites A and B would be commingled in the area. Therefore, these two SWMUs have been combined and a single sampling plan will cover both SWMUs.

An aerial photographic survey conducted in 1958 adds to the information that only a small area was affected by explosives; the area cleared of vegetation for and by the explosives is small (Figure 8.3-3). There is little evidence of vehicular activity around Firing Site B.

The amount of information regarding total quantities of hazardous materials expended at Firing Sites A and B is minimal. From interviews with experimenters of that era, one can conclude that natural uranium rather than depleted uranium was used to a large extent and that only a few kilograms were employed at a time; that other metals (presumably beryllium, lead, and mercury) were used but, again, in small quantities; and that only small amounts (10 to 20 lb) of HEs were used.

The aerial radiological survey conducted in 1982 by EG&G (Fritzsche 1989, 10-0033) (Figure 7.3-2 and Appendix H) did not detect radionuclides at levels above background of 10 pCi/m^2 (or approximately 100 pCi/g if one assumes the activity being measured is in the top centimeter of soil). Although this measurement is sensitive only to selected gamma-emitting radionuclides in the top portion of the soil, one would not expect the contamination existing in Sites A and B to have been totally hidden even if the sites were buried when the area was regraded.

Surface samples were taken and analyzed for the Sanitary Wastewater System Consolidation (SWSC) project (Fresquez 1991, 10-0003). The locations at which these samples were taken are shown in Figure 8.3-1 (PF-15A-1 to -3, PF-15B-2 and -3). Gross alpha, beta, and gamma activity was found at background levels, and toxicity characteristic leaching procedure (TCLP) metals were below Environmental Protection Agency (EPA) guidelines. Also, no semivolatile organic compounds (SVOCs) were detected. Total beryllium and uranium levels were at approximately background levels.

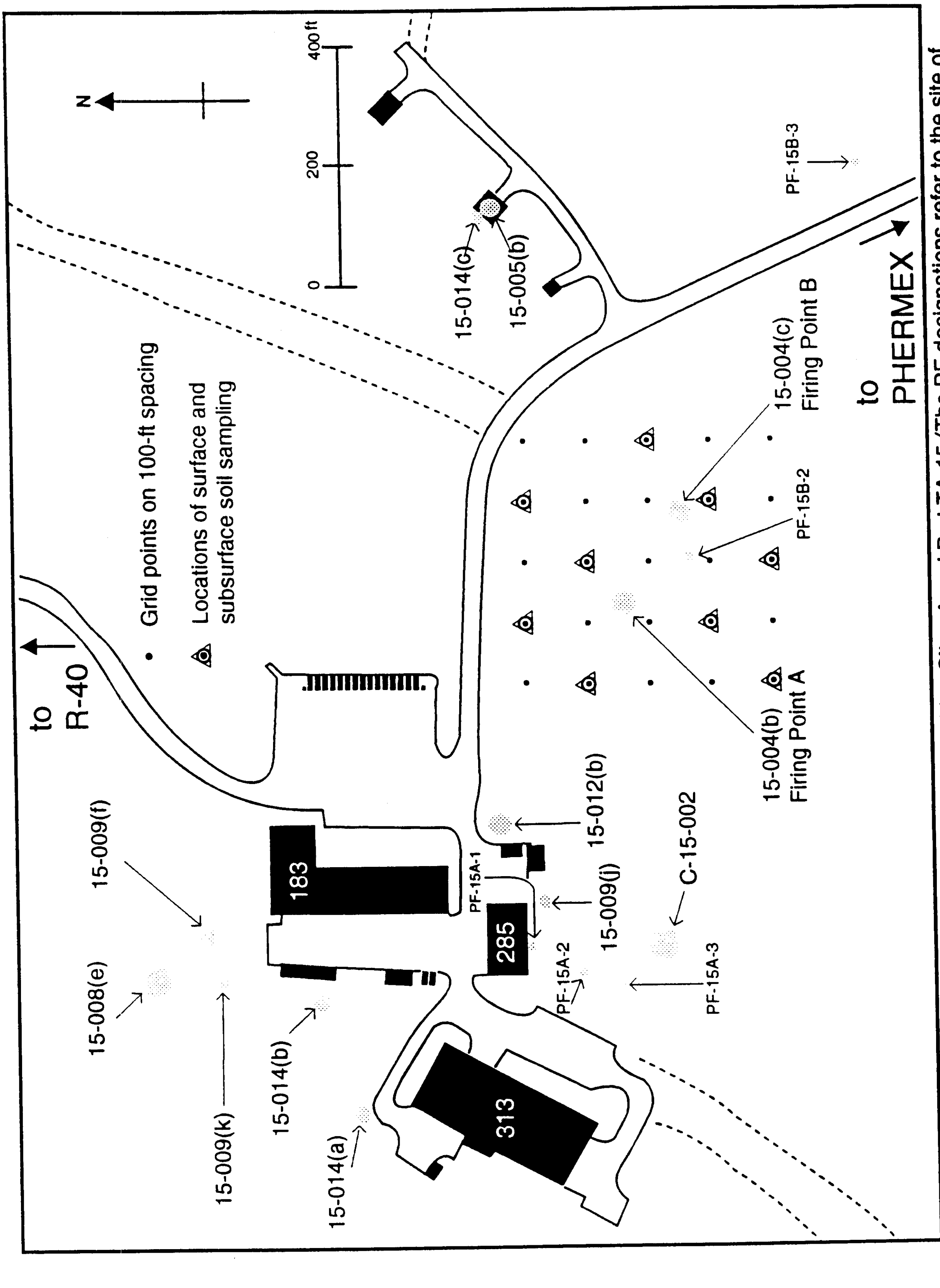


Figure 8.3-1 Site diagram and sampling grid for Firing Sites A and B at TA-15.(The PF designations refer to the site of samples taken prior to the installation of a new sewage line, June 1992. See Fresquez 1991,0003.)

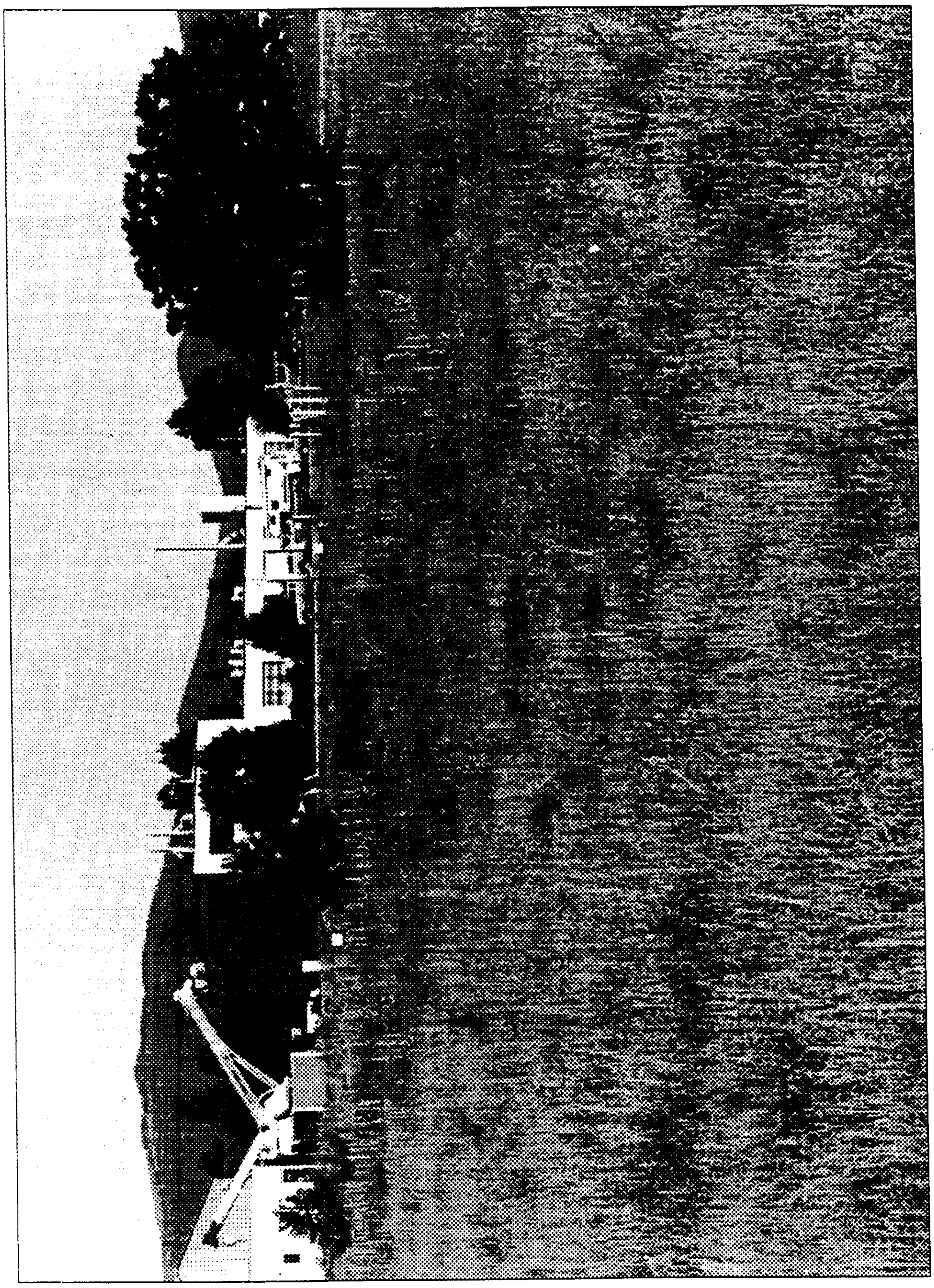


Figure 8.3-2 View of Firing Site A-B after it was regraded (photograph taken July 1992), looking northwest towards building R-183.

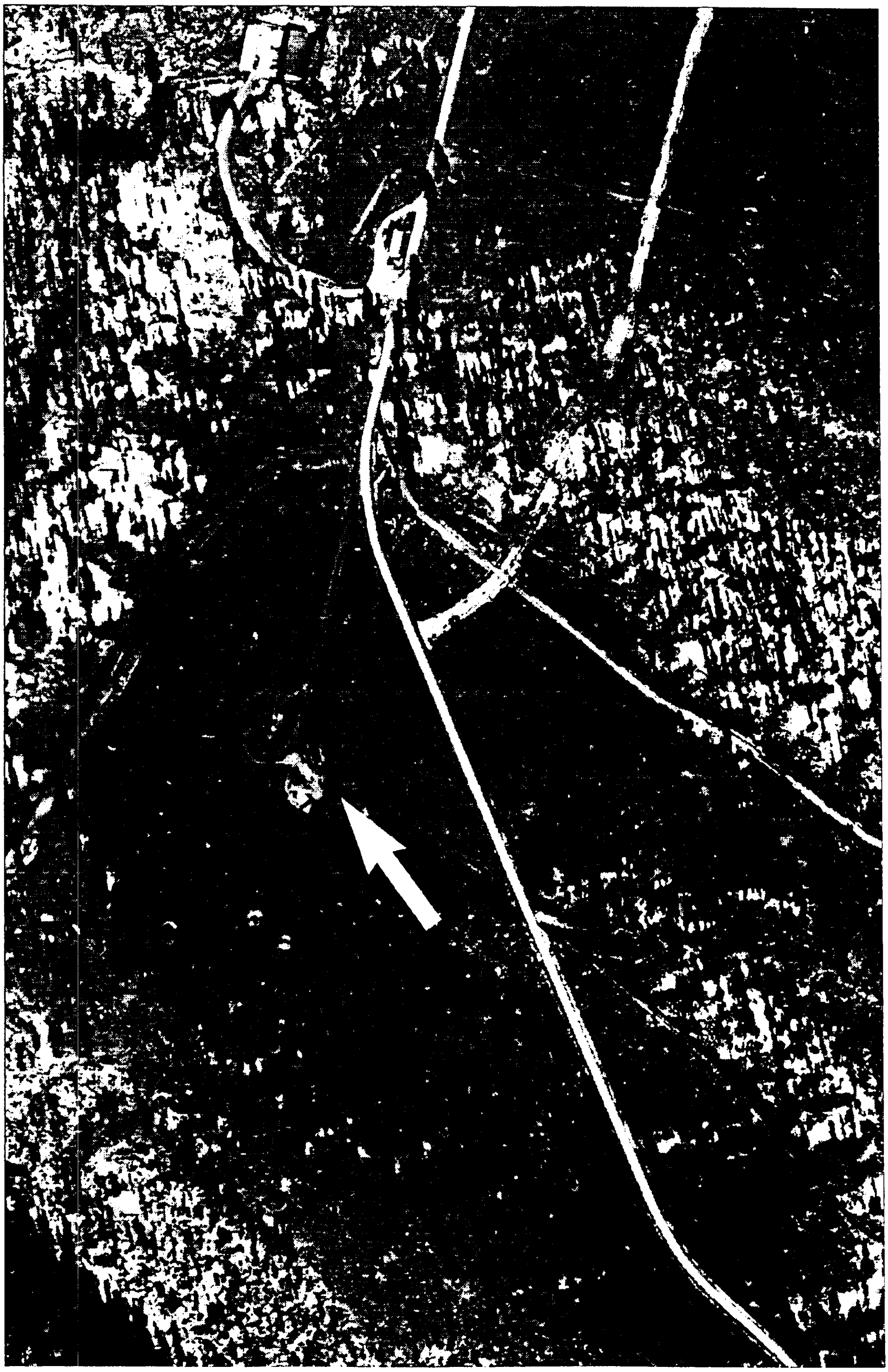


Figure 8.3-3 Aerial photograph no. 317 taken in 1958 of TA-15; the arrow points at Firing Site A-B.

8.3.2 Firing Sites A and B Sampling Plan

A grid will be laid out by a surveyor over the sampling area, which extends a nominal 200 ft in each direction from a point approximately midway between the supposed locations of A and B (Figure 8.3-1). The center of the grid will be located 265 ft south of the east-west road from TA-15-183 toward TA-15-130, and 190 ft east of a line extending from the eastern edge of the parking lot at TA-15-183. The grid will be spaced 100 ft in all directions. The number of samples collected within the grided area was determined through use of the statistically based sampling strategy presented in Chapter 4. For Firing Sites A and B, the percentage of the grided area that was assumed to be contaminated was at least 30%. The 30% contaminated area was deemed appropriate for this firing site and a number of others within OU 1086. The estimate was derived from a qualitative evaluation of how much of an area with a 200-ft radius of a smaller firing site could be contaminated. The statistical approach described in Chapter 4 gave a minimum number of samples to be collected as nine for achievement of a 95% confidence that contamination would not be overlooked. Since surface and subsurface soil sampling is desired for these firing sites (subsurface is desired because the site was regraded), nine surface and nine subsurface soil samples at 2-ft depth will be collected.

First, a land-based radiological survey will be completed using one of the following systems: tripod-mounted detectors, mobile gamma spectrometry systems, (as discussed in Appendix G) and hand held instrumentation.

The grid spacings were chosen to accomplish two things:

1. Maximum overlap of areas surveyed where the expectation for locating uranium is the highest. Such overlap would result in a better spatial definition of the concentration of any radioactive material, and
2. The inclusion of all areas within 200 ft of the center of the firing points.

Radiological surveys, which will be conducted from the center point of the grid and extend outward (as defined by the grid) around the center point. Radiological surveying can cease at the discretion of the project leader when the results for two successive incremental distances away from the center are at background levels. As in other cases, any clearly discernible chunks of uranium oxides will be physically removed at this point.

Sampling locations over the entire grid will be selected at random and will be surface sampled and also sampled at the 2-ft depth for analytes of concern. It is thought that 2 ft is sufficient to include all regraded material as the tuff begins at about that depth. This sampling is to ensure that COCs have not infiltrated into the soil or been covered up during the 1967 regrading process. To obtain these near-surface soil samples to depths of 2 ft, if digging is difficult, the spade-and-scoop method or hand augers will be used [standard operating procedure (SOP) 6.09] or possibly a "driven-casing" system. These soil samples will be field screened for alpha, beta, and gamma contamination, field screened for uranium, beryllium, lead, and field spot-checked for HEs. No Phase I field survey for mercury will be performed at firing sites other than E-F site where large amounts of testing were performed. If mercury proves to be of concern at E-F site, it will be evaluated at other sites during the Phase II investigations. Four surface and four subsurface will be submitted for laboratory analysis.

A summary of the sampling plan is presented in Table 8.3-1 and Appendix I presents the sampling and analysis tables for Firing Site A-B.

TABLE 8.3-1 OUTLINE OF SAMPLING PLAN FOR FIRING POINTS A AND B, SWMUs 15-004 (b) AND 15-004 (c) 1.6 x 10^3 sq. ft.	FIELD SCREENING					LABORATORY ANALYSIS		
	Alpha Beta Gamma	Uranium	Beryllium	Lead	HEs	Uranium	Beryllium	Lead
Surface Sampling	9	9	9	9	9	4	4	4
Subsurface Sampling (24")	9	9	9	9	9	4	4	4
TOTALS	18	18	18	18	18	8	8	8

8.4 Firing Site C; An Aggregate of SWMUs 15-004(d) and 15-004(a)

8.4.1 Site Description, History, and Potential Source Terms

Firing Point C was located at the "Y" of the road from the main TA-15 headquarters buildings to E-F site and the road to I-J site in TA-36 (Figure 8.4-1) (ENG-R 703, 1955, 10-0013). Building TA-15-7 was the headquarters building and was used as the control room for Firing Point C. The x-unit, TA-15-35, shown on location plan ENG-R 131 (1945, 10-0028), was at ground level and partially covered with a berm. Explosions were conducted within 25 ft of the x-unit. This distance indicated that the explosions were small in size.

The firing platforms [SWMU 15-004(a)] described in the SWMU report as "not located" were in reality concrete slabs at Firing Point C (ENG-C 12819, 1944, 10-0029) which were removed by 1947 (ENG-R 5110, 1983, 10-0022).

Firing Site C was in use from 1945 to perhaps 1948. A 1949 report (LASL 1949, 10-0047) does not mention C; thus, operations had probably been discontinued by that date. No written documentation on decommissioning has been found other than ENG-R 5110 (1983, 10-0022) where Firing Site C, x-unit (TA-15-35), was listed as having been removed in 1967 and the area regraded (Figure 8.4-2).

One can conclude from interviews with experimenters who worked at Firing Site C that source term information for Firing Site A is also applicable to Firing Site C. Again, radionuclides were not detected in the 1982 aerial radiological survey (Fritzsche 1989, 10-0033)(Figure 7.3-2). A surface sample was taken and analyzed as part of the SWSC (Fresquez 1991, 10-0003). The location at which this sample (PF-15C) was taken is located in Figure 8.4-1 in the vicinity of the removed x-unit, TA-15-35. Gross alpha, beta, and gamma activity was at background levels, and TCLP metals were below EPA guidelines. Also, no SVOCs were detected. Total beryllium and uranium levels were at approximately background levels. During the summer of 1992 a new sewer line was installed just south of the road connecting R40 to TA-36, causing much ground disturbance (Figure 8.4-2).

8.4.2 Firing Site C Sampling Plan

A similar radiological survey and surface and subsurface sampling plans as those developed for Firing Sites A and B will be carried out at Firing Site C.

The grid will be centered at the island in the Y of the road extending from TA-15-40 to Firing Site E-F and I-J Site in TA-36 (Figure 8.4-1). The grid will be spaced 100 ft in all directions to 200 ft in each direction. A summary of the sampling plan is presented in Table 8.4-1. First a land-based radiological survey will be conducted with tripod-mounted detectors or mobile gamma spectrometry systems, as discussed in Appendix G or with equivalent detectors.

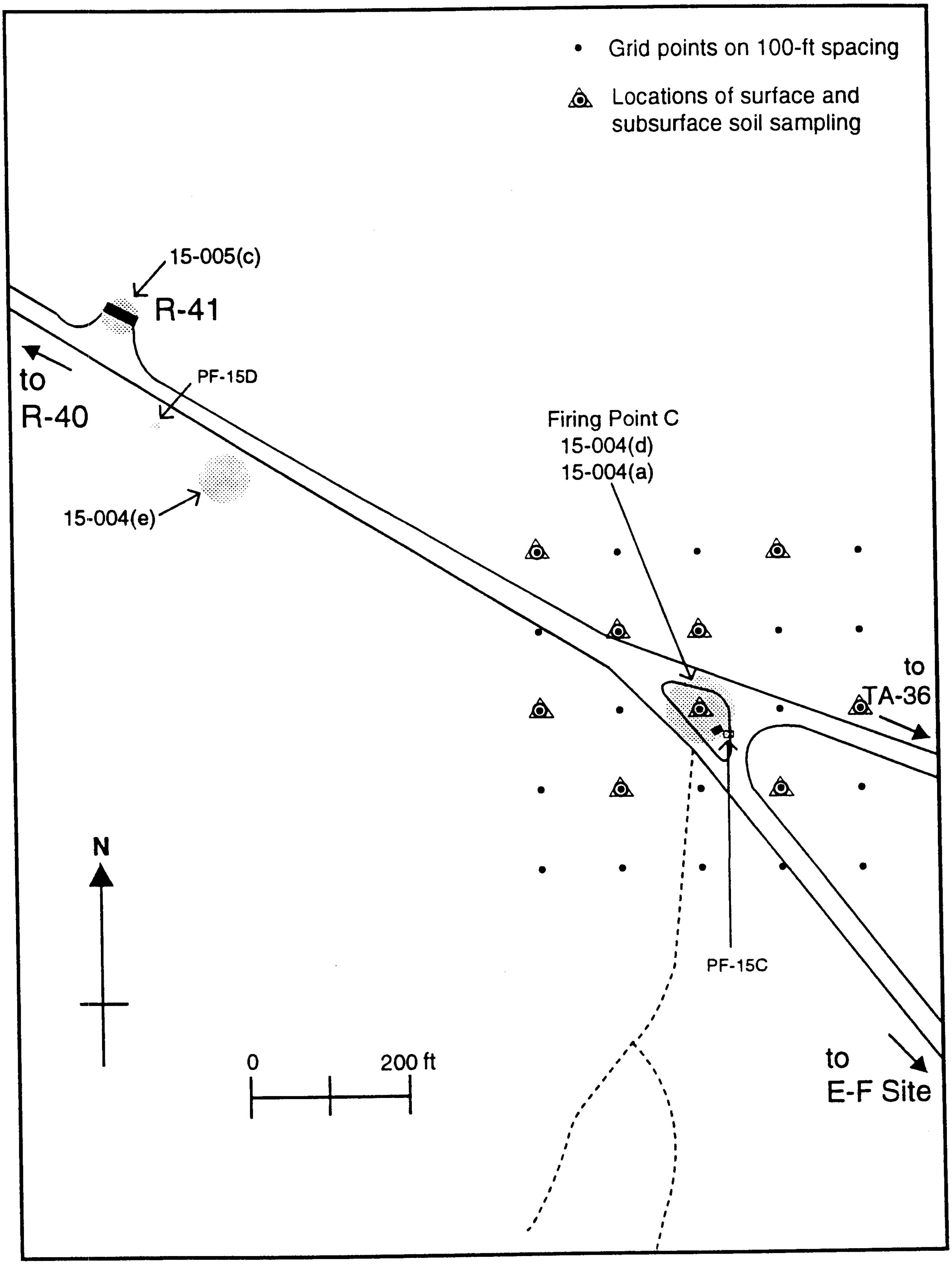


Figure 8.4-1 Site diagram and sampling grid for Firing Point C at TA-15.

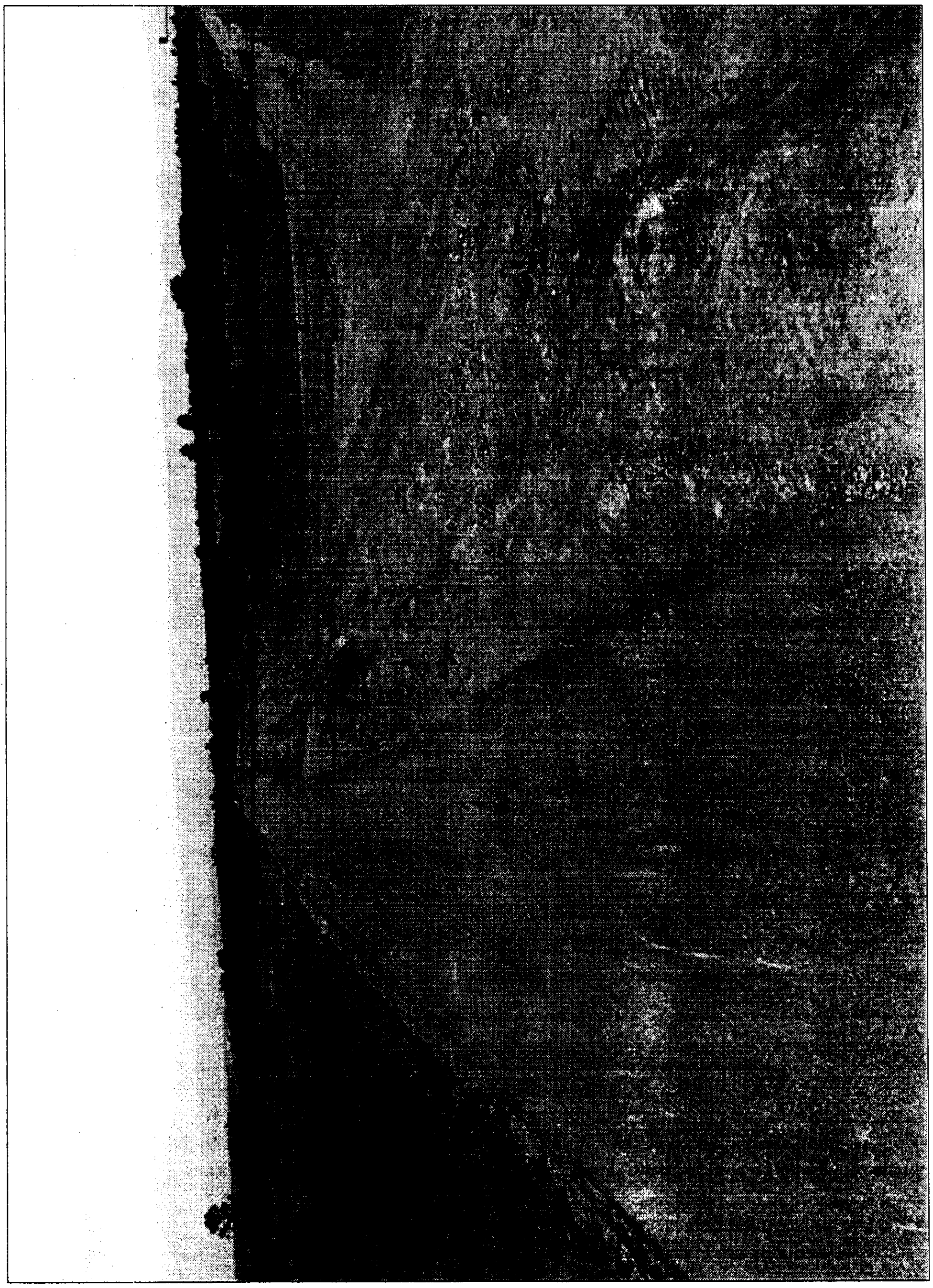


Figure 8.4-2 Photograph taken in July 1992 of regraded Firing Site C at the junction of the two roads . The disturbed earth south of the road leading to TA-36 (see Figure 8.4-1) is due to the new sewage line installed in June 1992.

Radiological surveying can stop at the discretion of the project leader when the results for two successive incremental distances away from the center are at background levels. As in other cases, any clearly discernible chunks of uranium oxides will be physically removed at this point.

The land-based radiological survey will be followed by a chemical field survey for uranium, lead, and beryllium and field spot test for HEs.

The locations on the roads will not be sampled for chemical analysis unless samples taken at the edge of the road indicate that such analyses are necessary.

This site is very similar to Firing Sites A and B in that the percentage of area that might be contaminated, nine sampling locations over the grid (but excluding that under the road) have been selected at random and surface samples and also subsurface samples (to 24 in.) will be collected. This sampling is to ensure that (COCs) have not infiltrated into the soil or been covered up during the 1992 regrading process. To obtain these near-surface soil samples to depths of 2 ft, the spade-and-scoop method or hand augers, (SOP 6.09) or possibly a "driven-casing" system, will be used (if digging is inappropriate). These soil samples will be field screened for alpha, beta, and gamma contamination, field screened for uranium, lead, beryllium, and field spot-checked for HEs. Four samples from each location (i.e., surface and subsurface), which is approximately 50% of the total number collected, will be submitted for Level III analysis for uranium, beryllium, and lead.

A summary of the sampling plan is presented in Table 8.4-1 and the sampling and analysis table for Firing Site C is in Appendix I.

TABLE 8.4-1 OUTLINE OF SAMPLING PLAN FOR FIRING POINT C SWMUs 15-004 (a) AND 15-004 (d) 1.6 x 10^3 sq. ft.	FIELD SCREENING									LABORATORY ANALYSIS									
	Alpha Beta Gamma	Uranium	Beryllium	Lead	HEs						Uranium	Beryllium	Lead						
Surface Sampling	9	9	9	9	9						4	4	4						
Subsurface Sampling (24")	9	9	9	9	9						4	4	4						
TOTALS	18	18	18	18	18						8	8	8						

8.5 Aggregate of Firing Site G, Nearby Surface Disposal, Area of Concern, and the Boneyard; SWMUs 15-004(g), 15-008(c), 15-009(i), and 15-001, and Area of Concern C-15-001

8.5.1 Site Description, History, and Potential Source Terms

Firing Site G [SWMU 15-004(g)] is located in the southern half of TA-15 (Figure 8.5-1). By 1949, Firing Site G, in addition to Firing Sites A, B, E, and F, was in use (Reider 1949, 10-0006). ENG-R 130 (1956, 10-0027) indicates that TA-15-9 was the control chamber; TA-15-28, the x-unit; and TA-15-16, a barricade to the south of the control chamber. Only TA-15-9, the control chamber, remains today; the x-unit and the barricade were removed in 1967 (ENG-R 130, 1956, 10-0027) (Figure 8.5-1). The control chamber has been suggested to the Department of Energy Albuquerque Operations Office (DOE/AL) as an item for the decontamination and decommissioning (D&D) program (Booth 1992, 10-0036) after 1998.

The explosions carried out at Firing Site G were somewhat larger than those at A or B. However, there is conflicting verbal information pertaining to the materials that constituted the tests. Uranium (either natural or depleted), other metals, and HEs were used at the site. It is known that small pieces of metallic uranium were found on top of TA-15-9 during the 1986 Comprehensive Environmental Assessment and Response Program (CEARP) field survey (DOE 1987, 0264).

Hand-held detectors used during a radiological survey measured approximately 10 000 cpm with a 0.5 mR/h exposure rate at a location between building TA-15-233 and the road north of it (Schlapper 1991, 10-0009). This reading was in the general location of the area of the sampling plan proposed in Subsection 8.5.2 for Firing Site G. As at other sites, chunks of uranium may be responsible for the high radiological readings.

The 1982 aerial survey by EG&G (Fritzsche 1989, 10-0003) (Figure 7.3-2) did not detect radionuclides above background levels at Firing Site G or the nearby surface disposal area.

The Laboratory's SWMU report (LANL 1990, 0145) states that residues from several experiments were disposed of on the surface in the area of SWMU 15-008(c) that consisted of several small areas near TA-15-233, west of TA-15-233, and south of the road. These locations are all within the area of the sampling plan proposed in Subsection 8.5.2 for Firing Site G, so these SWMUs have been aggregated together into a single sampling plan (see Figure 8.5-1). A radiological survey and soil sampling of the area of SWMU 15-008(c) was conducted in 1987 (DOE 1989, 0271). Exposure rates up to 400 µR/h and uranium concentrations in soil samples of up to approximately 0.7% were measured. However, no detectable HEs were found in any of the samples.

During the 1988 environmental restoration (ER) site reconnaissance visit, a soil pile contaminated with radionuclides was noted. This pile is denoted in the SWMU report as AOC C-15-001 (Figure 8.5-2, foreground). This area is within the sampling plan for Firing Site G and is also part of the aggregate.

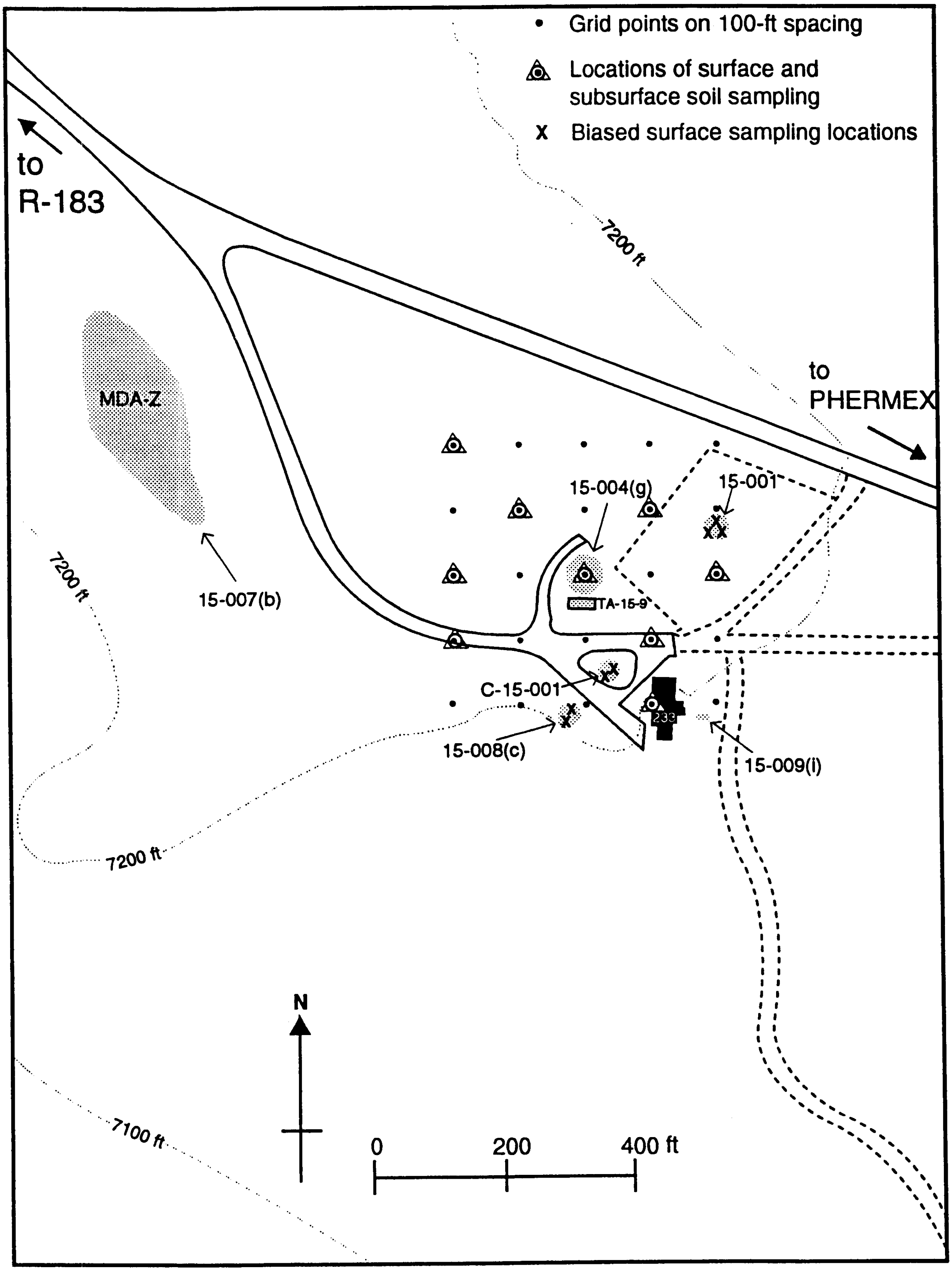


Figure 8.5-1 Site diagram and sampling grid for Firing Site G at TA-15.

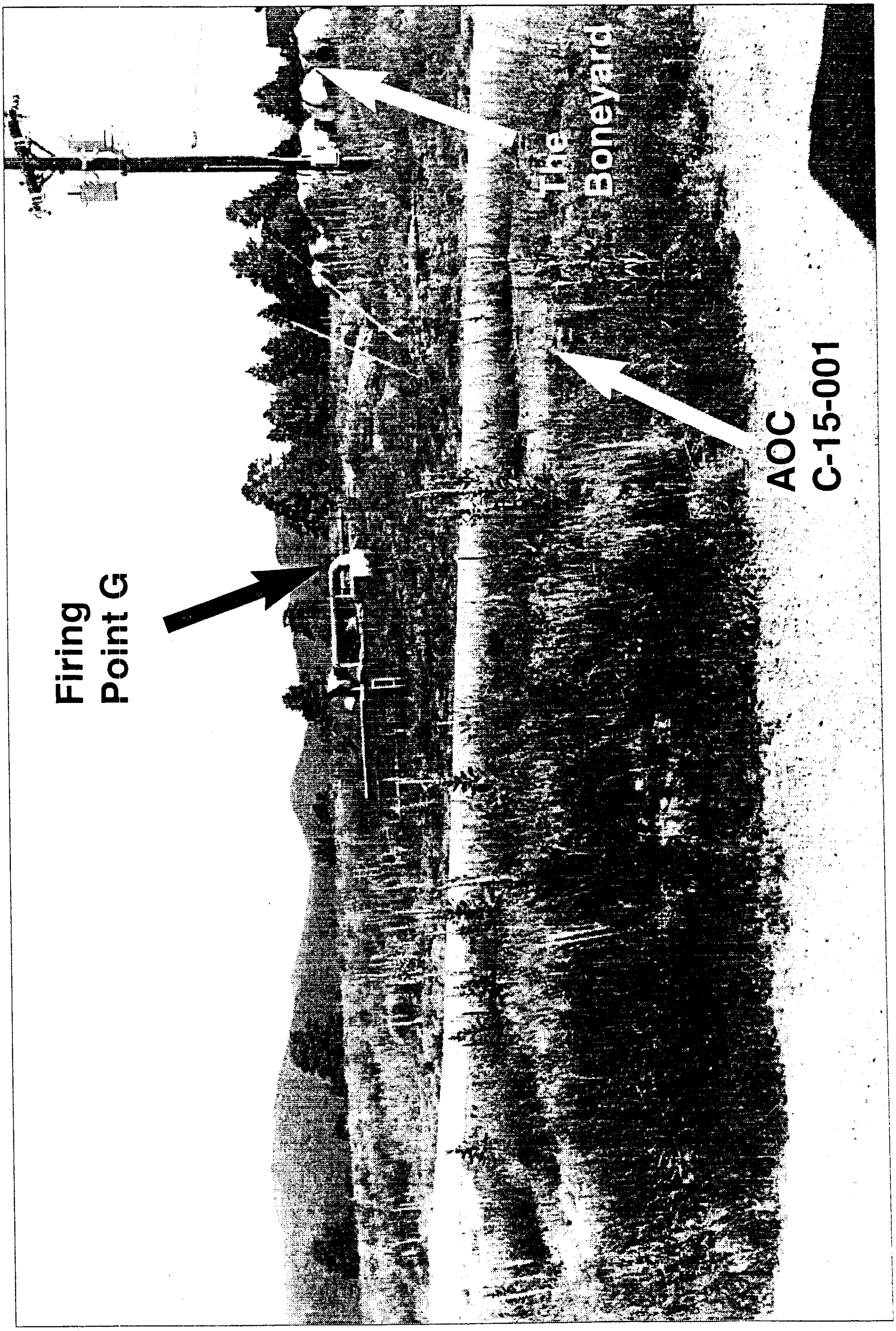


Figure 8.5-2 The Boneyard (15-001) (upper right), a surface disposal area south of Firing Point G [15-004(g)] (center) at TA-15. AOC C-15-001 is shown in the foreground (photograph taken July 1992).

SWMU 15-001, the Boneyard, is an area to the north and east of TA-15-233 (Figure 8.5-2) that is used to store equipment, steel, and experimental vessels. Figure 8.5-3 shows the related residue dispersal area, 15-008(c). It is unlikely that storage of this equipment has resulted in any hazardous materials being added to the soil or the air. The experimental vessels are cleaned (at site R-183) before being brought here and, in addition, are kept sealed as a precaution against any remaining hazardous material. This area is also part of the SWMU aggregate and is within the sampling plan for Area G.

8.5.2 Sampling Plan for Firing Site G and Nearby Surface Disposal

A radiological survey and surface and subsurface sampling will be conducted at Firing Site G and related areas. In addition to field screening for radionuclides, lead, and HEs, we will also sample for volatile organic compounds at SWMU 15-009(i), the active septic system.

The sampling locations as shown in Figure 8.5-1 includes placement of a 100-ft grid extending 200 ft in all directions from Firing Site G. It is known that explosions were larger at Firing Site G than at Firing Sites A and B, but confidence is low that the contaminated area exceeds 30% of the total area included in the grided area. Therefore, a minimum number of nine surface and nine subsurface samples will be randomly placed over the grid.

For this aggregate of SWMUs, only Firing Site G is large enough to warrant a grid placement. The sites of other PRSs will be sampled in a biased manner. It should be noted, however, that the grid for Firing Site G encompasses the smaller PRSs and the radiological survey will at least include the areas around those PRSs. We propose taking three additional samples outside the grid at 15-001 and two additional nongrid samples at both 15-008(c) and C-15-001. Radiological contamination has previously been found at the surface disposal area, SWMU 15-008(c) (DOE 1989, 0271) (Figure 8.5-3). In addition to radiological surveying, all samples will be field screened for uranium, lead, and beryllium and HEs. Some samples will then be sent for laboratory analysis, as shown in Table 8.5-1.

Two sludge samples will be taken at the septic tank, SWMU 15-009(i), and field-screened for radiological and chemical (U, Pb, Be, HEs, and volatile organics) contaminants. Laboratory analyses will follow including volatile and semivolatile organic compounds by the methodologies listed in Table 4.7-3.

A summary of the sampling plan is shown in Table 8.5-1 and the sampling and analysis tables for Firing Site G and related area are presented in Appendix I.

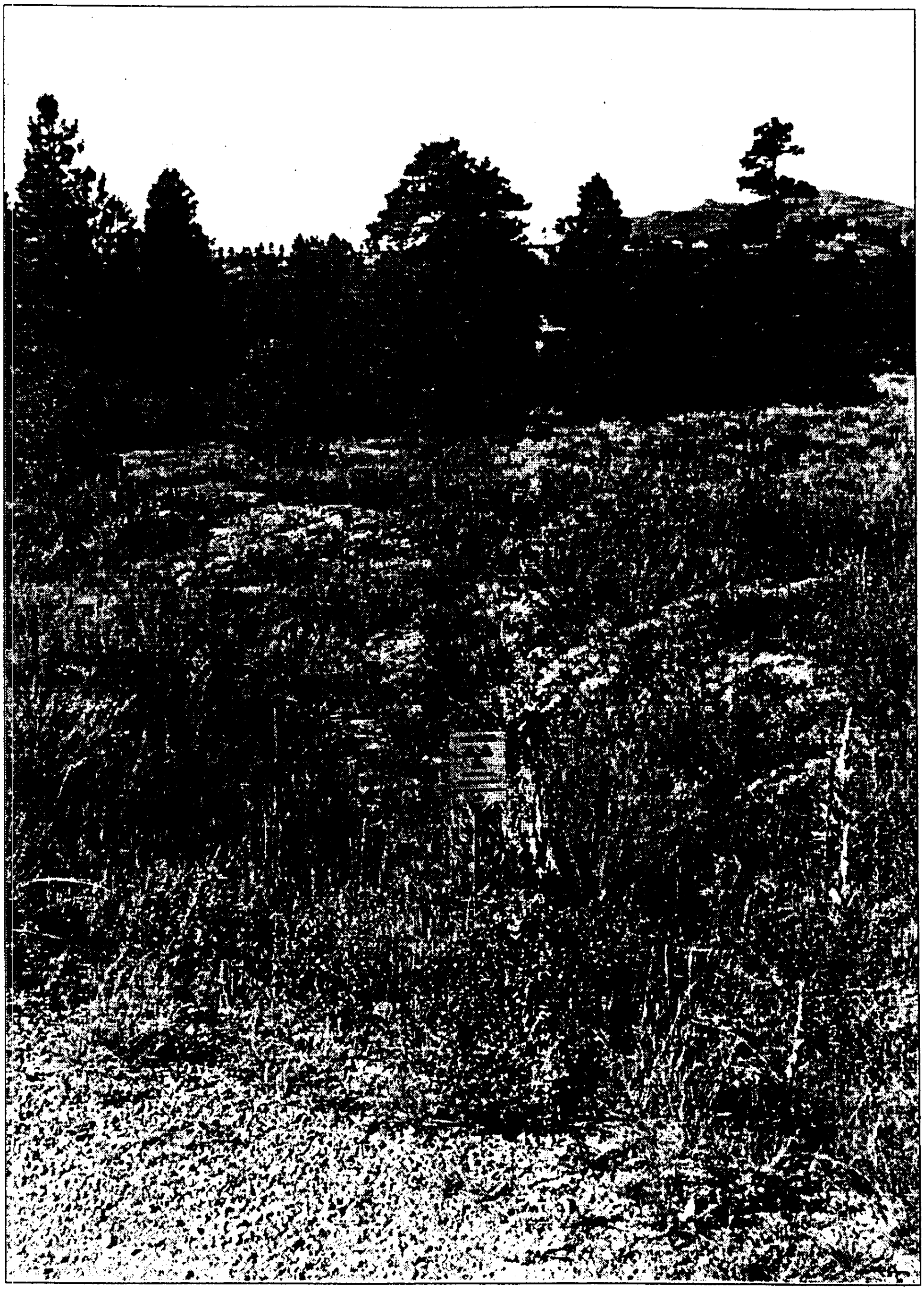


Figure 8.5-3 Residue disposal area [15-008(c)] at Firing Site G, looking southwest (photograph taken July 1992).

TABLE 8.5-1

SAMPLING PLAN FOR FIRING SITE G AND RELATED PRSs. SWMUs 15-004(g), 15-001, 15-008 (c), AND AOC C-15-001

1.6 x 10^5 sq. ft.

	FIELD SCREENING									LABORATORY ANALYSIS									
	Alpha Beta Gamma	Uranium	Beryllium	Lead	HEs	VOCs					Uranium	Beryllium	Lead	HEs	VOCs	SVOCs			
A. SWMU 15-004 (g)																			
Surface Sampling	9	9	9	9	9						4	4	4						
Subsurface Sampling (24")	9	9	9	9	9						4	4	4						
B. SWMU 15-001	3	3	3	3	3						3	3	3						
C. SWMU 15-008 (c)	2	2	2	2	2						2	2	2						
D SWMU 15-009 (i) (sludge)	2	2	2	2	2	2					2	2	2	2	2	2			
E AOC C 15-001	2	2	2	2	2						2	2	2						
TOTALS	27	27	27	27	27	2					17	17	17	2	2	2			

8.6 Firing Site H, SWMU 15-004(h) and Related PRSs: SWMU 15-010(c) and AOC C-15-011

8.6.1 Site Description, History, and Potential Source Terms for SWMU 15-004(h)

Located at the PHERMEX firing site is the inactive Firing Site H [SWMU 15-004(h)] (Figure 8.6-1). Built in 1948, this firing site was probably used until 1953 for larger explosions than those set off at Firing Point A (Section 8.3). The camera chamber (TA-15-92) still remains on the site and has been proposed for decontamination and decommissioning (D&D) (Booth 1992, 10-0036). Activities at PHERMEX do not impact this SWMU, with the possible exception of hazardous debris that may have been deposited on the soil by explosions set off at PHERMEX.

As a firing site, SWMU 15-004(h) has the potential for uranium-238, beryllium, lead, and residual HE contamination. Because HE contamination has not been observed at firing sites such as these on TA-15 (DOE 1989, 0271), the likelihood of HE contamination being found here is small. Nevertheless, spot tests for HEs will be undertaken.

The EG&G aerial survey results shown in Figure 7.3-2 (Fritzsche 1989, 10-0033) (Appendix H) show that in 1982 the PHERMEX site contained the second largest concentration of radionuclides in the soil surfaces of all the firing sites on OU 1086. This contamination is centered on the PHERMEX site but naturally includes Firing Site H.

Two additional PRSs, SWMU 15-010(c), AOC C-15-011, are considered in conjunction with Firing Site H because their locations (Figure 8.6-2) are on or close to the grid suggested for Firing Site H.

8.6.2 Firing Site H Sampling Plan

A similar radiological survey and surface and subsurface sampling plan as that developed for Firing Sites A and B will be carried out at Firing Site H. However, its location within the much larger PHERMEX firing site adds to the potential difficulty of determining whether contamination detected outside of the boundaries of Firing Site H is due to Firing Site H or PHERMEX. As a result, the decision was made to perform biased sampling within Firing Point H and to place a grid over the site that extends out 200 ft from the center. The sampling grid is presented in Figure 8.6-2.

The grid will be 100 ft from the center and will continue to the full 200 ft in each direction. First a land-based radiological survey will be done with tripod-mounted detectors or mobile gamma spectrometry systems, as discussed in Appendix G or hand held instrumentation.

Nine locations over the grid have been selected at random. This selection is the appropriate number for Phase I investigations based on the judgment that Firing Site H does not differ from other firing sites examined in this chapter. The surface will be sampled and also sampled at the 2-ft depth for analytes of

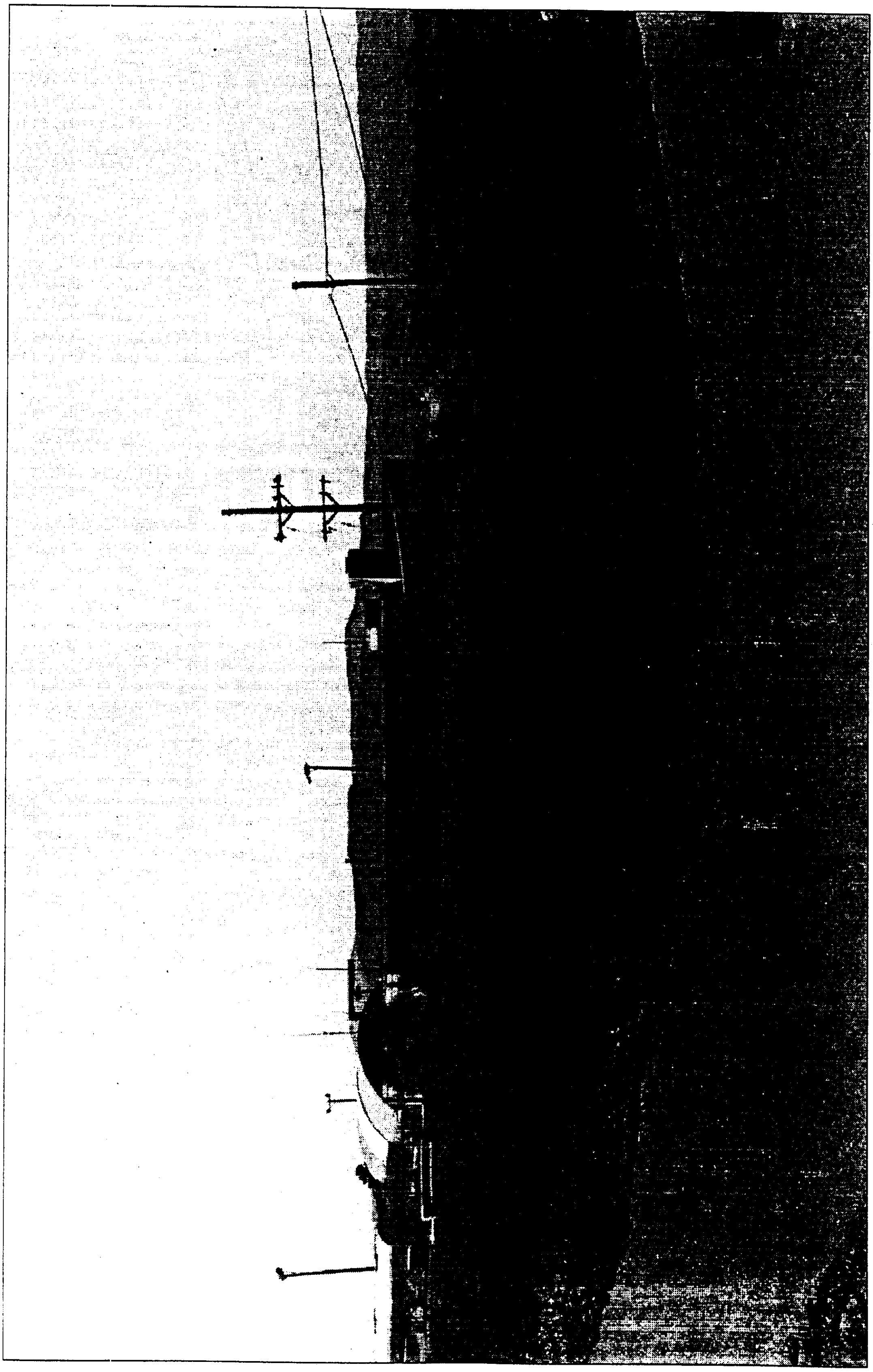


Figure 8.6-1 Firing Point H, the mound with PHERMEX in the background (photograph taken July 1992), looking southeast.

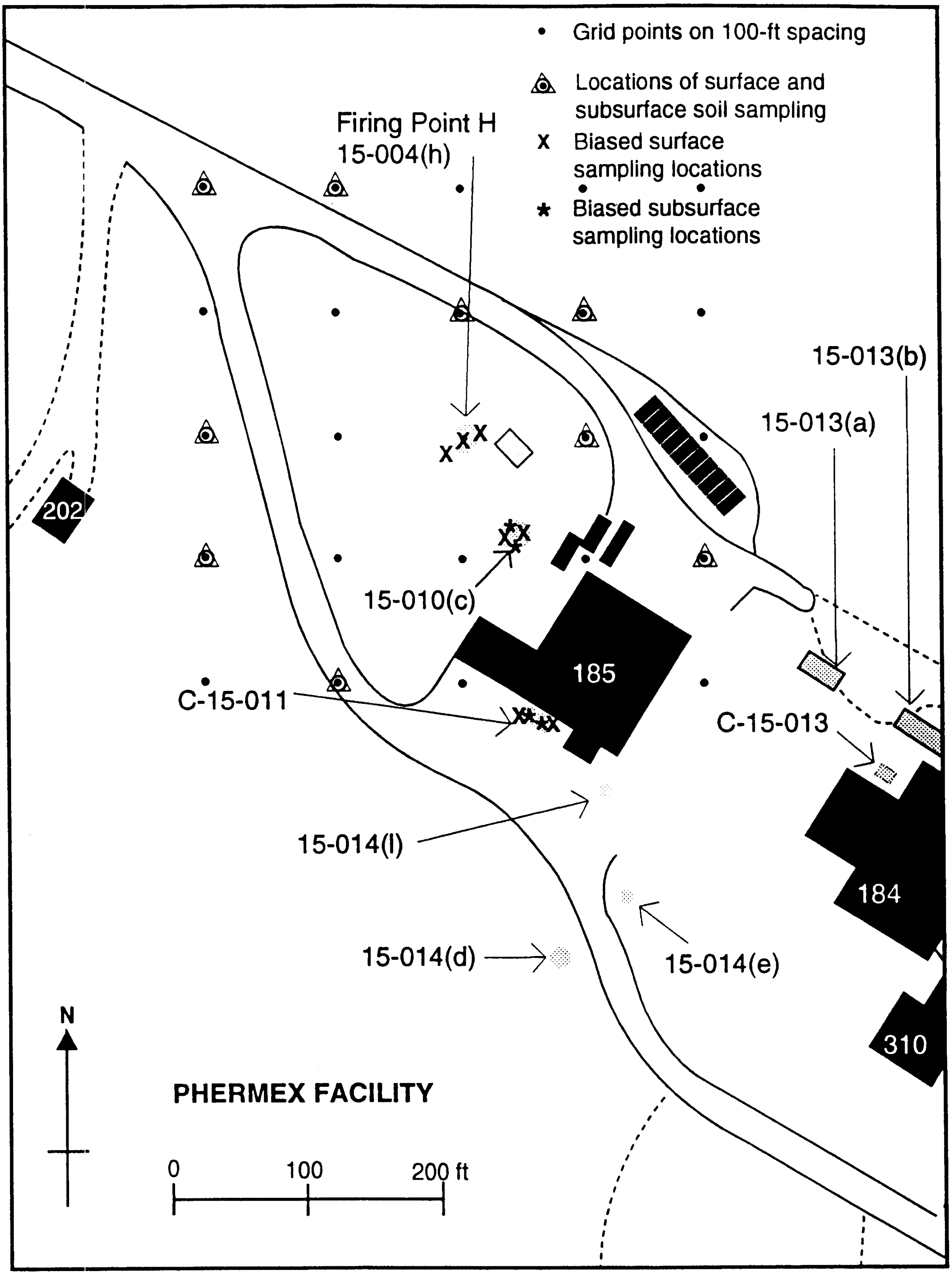


Figure 8.6-2 Site diagram and sampling plan for inactive Firing Site H, SWMU 15-004(h).

concern. It is thought that 2 ft is sufficient to include all regraded material. These samplings are intended to ensure that COCs have not infiltrated into the soil or been covered up during the 1992 regrading process. To obtain these near-surface soil samples to depths of 2 ft, workers will dig, if appropriate, or else use the spade-and-scoop method, hand augers (SOP 6.09) or possibly will use a "driven-casing" system. The soil samples they obtain will be field-screened for alpha, beta, and gamma contamination, field spot-checked for HEs and field screened for uranium, lead, and beryllium and then submitted for Level III analysis for uranium, beryllium, and lead.
An additional three samples will be collected from within Firing Site H and analyzed for the same substances.

A summary of the sample plan is shown in Table 8.6-1 and the sampling and analysis tables presented in Appendix I.

8.6.3 SWMU 15-010(c); Septic System, Drainline

The SWMU report (LANL 1990, 0145) is in error regarding a drain from building TA-15-92 [SWMU 15-010(c)]. Engineering drawings ENG-R 719, (1950 10-0014), and ENG-C 942, (1950, 10-0017) do show building TA-15-92 and a 5-in. steel drainline that runs 105 ft south from just outside the building to the edge of Water Canyon. This drainline collects water from the landing at the bottom of the steps leading to building TA-15-92. This landing is below grade, exposed to the weather, and requires a drain to remain dry. No hazardous materials other than the contents of rainfall enter into this drainline.

As it is difficult to envision specific contaminants being released, the two surface soil samples to be collected at the outfall will be analyzed for a broad group of VOCs, SVOCs by methodologies listed in Table 4.7-3 and metals constituents. A summary of the sample plans is given in Table 8.6-1.

8.6.4 AOC C-15-011; Underground Fuel Storage Tank

Initially a 218-gal. underground fuel storage tank designated TA-15-274 was located immediately south of building TA-15-185. This storage tank was removed in 1987 (Francis 1992, 10-0002). The soil will be sampled at depth preferably at 2 to 3 ft below the recorded depth of the tank bottom when it was removed. Two samples will be analyzed for VOCs and SVOCs as listed in Table 4.7-3. We propose to use a gasoline powered drill.

A summary of the sample plans is given in Table 8.6-1 and the sampling and analysis tables for Firing Site H and related PRSs are in Appendix I.

TABLE 8.6-1 OUTLINE OF SAMPLING PLAN FOR FIRING SITE H, SWMU 15-004 (h) AND ASSOCIATED PRSs: SWMU 15-010 (c) AND C-15-011 1.6 x 10^5 sq. ft.	FIELD SCREENING									LABORATORY ANALYSIS									
	Alpha Beta Gamma	Uranium	Silver	Beryllium	Lead	Chromium	HEs	VOCs			Uranium	Silver	Beryllium	Lead	Chromium	VOCs	SVOCs		
SWMU 15-004 (h)																			
Surface Samples	12	12		12	12		12				6		6	6					
Subsurface Samples (to 24")	12	12		12	12		12				6		6	6					
SWMU 15-010 (c) Subsurface		2	2	2	2	2		2			2	2	2	2	2	2	2		
AOC C-15-011 Subsurface								2								2	2		
TOTALS	24	26	2	26	26	2	24	4			14	2	14	14	2	4	4		

8.7 Unnamed Burn Pit; SWMU 15-002

8.7.1 Site Description, History, and Potential Source Terms

During the 1986 CEARP field survey (DOE 1987, 0264), one former employee recalled two occasions when oil/uranium mixtures were burned 100 to 150 yd west of E-F site. Also, in 1992, a different employee recalled that an HE burn area was located across the road from TA-15-20. He could not recall the exact location.

Initial construction at TA-15 (R-site) was completed in 1944 (LASL 1944, 10-0044). Engineering drawing ENG-C 15208 (1956, 10-0028) shows a trash-burning area about 900 ft southwest of the TA-15-7 control room and across the road from TA-15-20.

A site diagram is shown in Figure 8.7-1. Aerial photographs taken in 1949–1950 (Figure 8.7-2) show a bermed area due east of TA-15-20, approximately 600 ft from the north-south road. The berm, about 3 ft high, surrounds the pit on three sides; it is not present on the east side of the pit. A small, intermittently used dirt road leads to this bermed area. Aerial photographs taken in 1958 (Figure 8.7-3) show the bermed area and road still in place, although the road had not been used for some time and was overgrown with vegetation. Today the condition of the bermed area and road is still the same. It is reasonable to conclude that the burn areas recalled by the two former employees are the same location and that the location is the one shown some 600 ft east of the road near TA-15-20. This unnamed burn pit is now considered to be SWMU 15-002 for this work plan.

The aerial radiological survey conducted in 1982 by EG&G/Energy Measurements (Fritzsche 1989, 10-0033) did not detect radionuclides at levels above background. This finding indicates that if uranium was burned at this site, the quantities were small and current environmental levels are probably below the screening action levels described in Chapter 4 in this work plan.

8.7.2 Unnamed Burn Pit Sampling Plan

Because of the undocumented use of this bermed area, it is necessary to establish whether there are any COCs at all and, if so, if they are above screening action levels. The area involved is about 0.1 the size of previously considered firing sites. After an initial radiological survey, four samples will be taken, two surface and two subsurface (at 24 in.). The locations are at the bottom center of the pit and along the inside of the berm, as shown in Figure 8.7-1. The samples will be field screened for radiation, metals (U, Pb, Be), HEs and, subsurface only, VOCs. These will be followed by laboratory analyses as shown in Table 8.7-1 including SVOCs, using methods shown in Table 4.7-3. It is thought to be necessary to take two subsurface samples because the berm predates the burning. There is concern that stormwater, which collects occasionally in the bermed area has caused downward migration of contaminants that may have been introduced to the pit. These analyses should permit us to decide whether or not uranium and other metals, HEs, or organic contaminants still reside in the bermed area.

Table 8.7-1 presents a summary of the sampling plan and the sampling and analysis tables for the burn pit, are given in Appendix I.

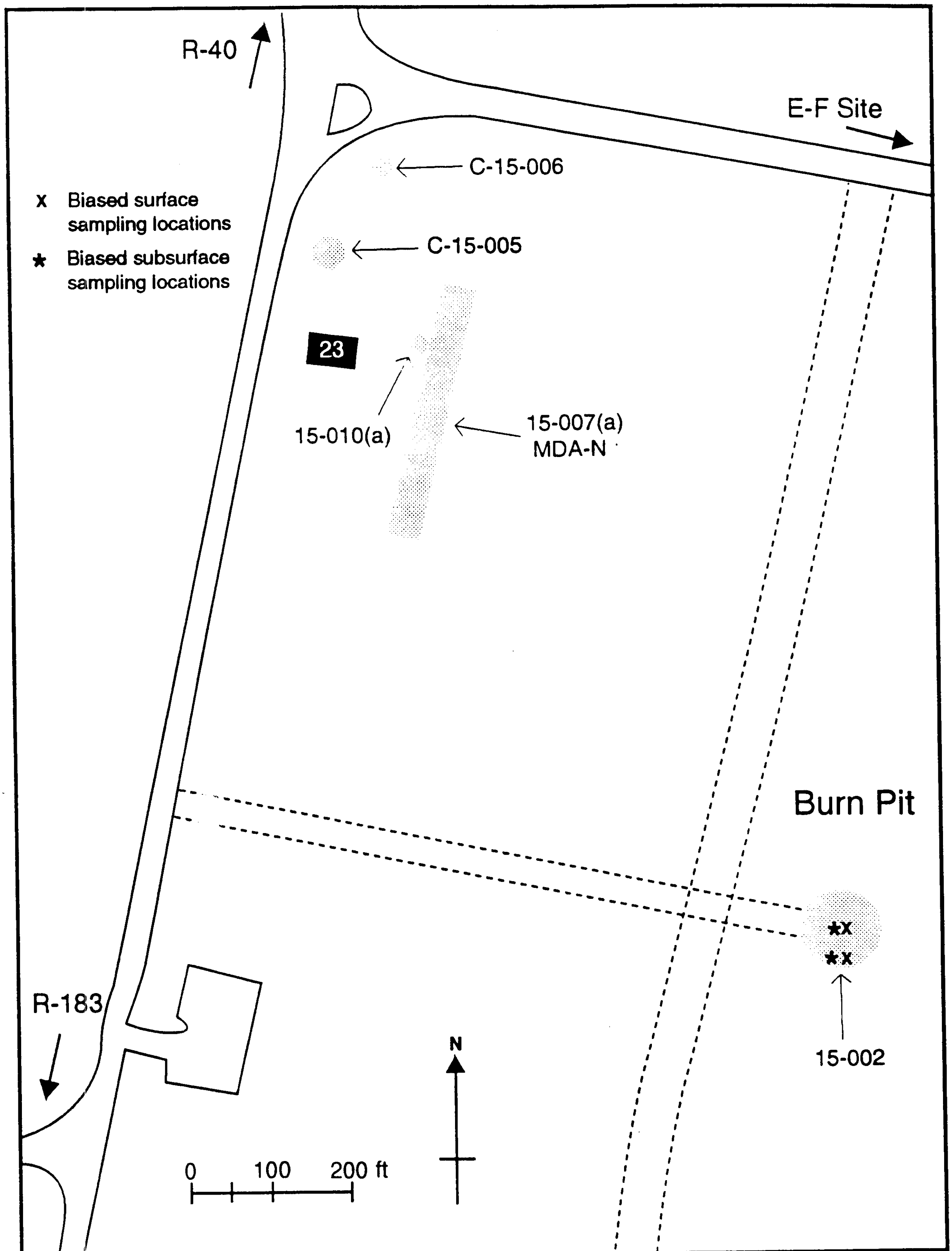


Figure 8.7-1 Site diagram including the burn pit, and MDA-N; also shown are the sampling points at the burn pit.

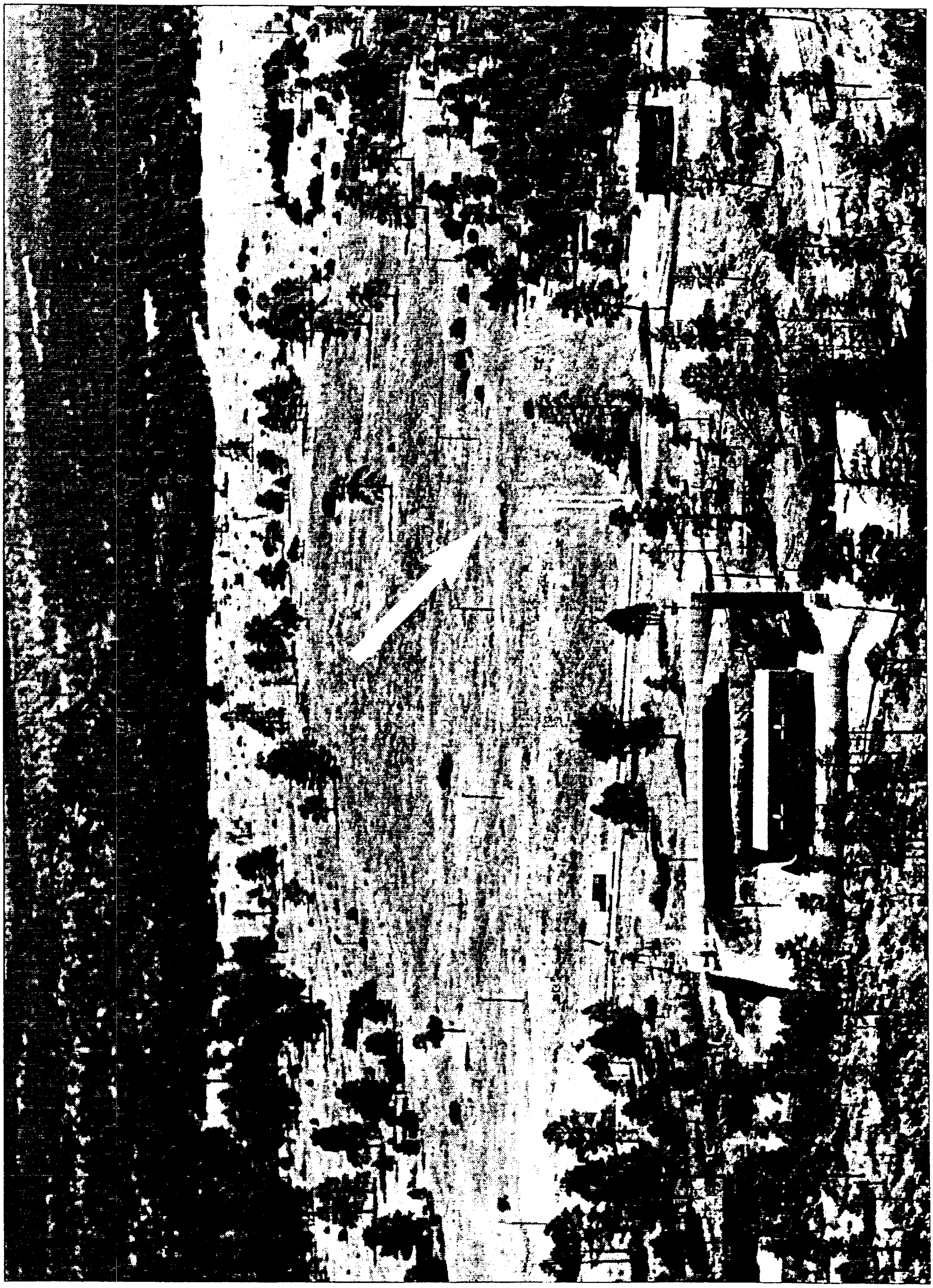


Figure 8.7-2 Aerial photograph no. 12225 taken in 1949 showing the unnamed burn pit; SWMU 15-002.

Figure 8.7-3 Aerial photograph no. 317 taken in 1958 showing the unnamed burn pit, SWMU 15-002.

TABLE 8.7-1

OUTLINE OF SAMPLING PLAN FOR UNNAMED BURN PIT

SWMU 15-002

8×10^3 sq. ft.

	FIELD SCREENING						LABORATORY ANALYSIS				
	Alpha Beta Gamma	Uranium	Beryllium	Lead	HEs	VOCs	Uranium	Beryllium	Lead	VOCs	SVOCs
SWMU 15-008											
Surface Samples	2	2	2	2	2		2	2	2		2
Subsurface Samples (24")	2	2	2	2	2	2	2	2	2	2	2
TOTALS	4	4	4	4	4	2	4	4	4	2	4

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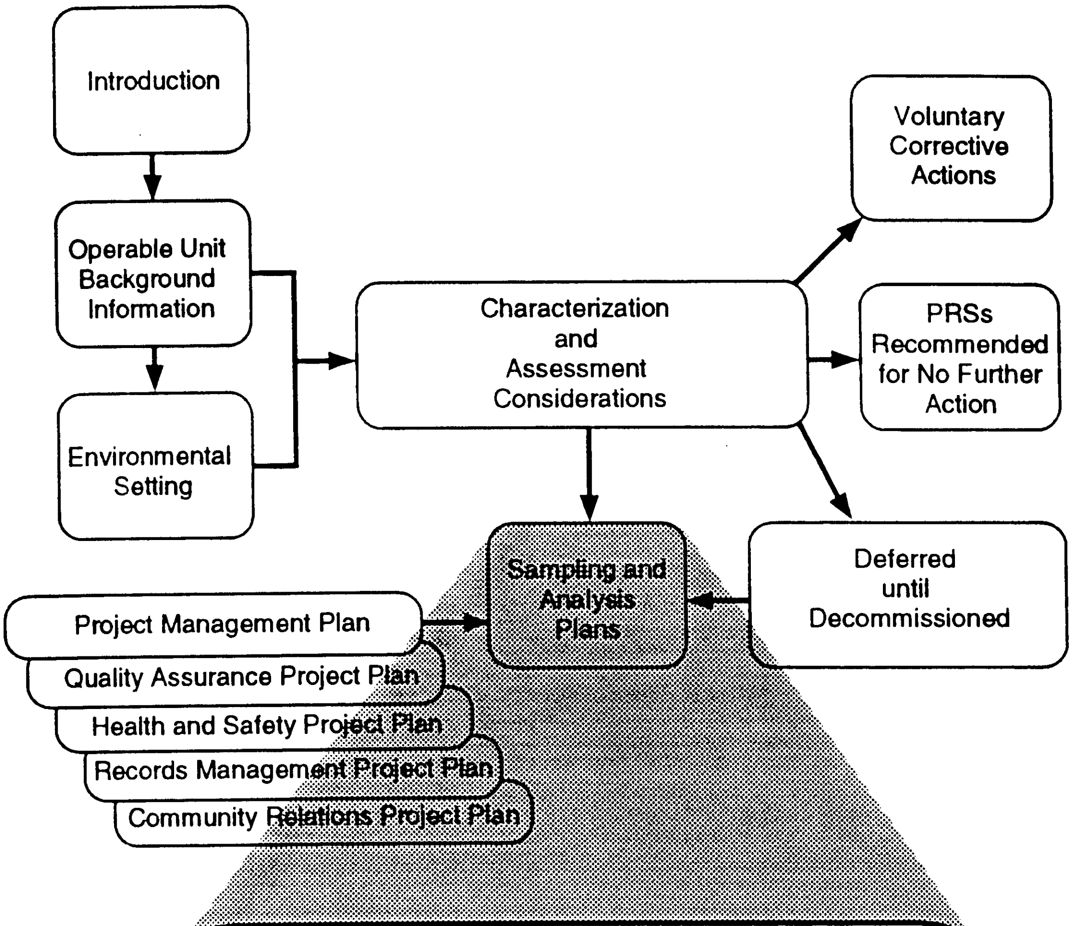
CHAPTER 9



Sampling and Analysis Plans

- Landfill MDA-N and Related Areas
- Landfill MDA-Z
- Surface Disposal at R44

9.0 SAMPLING AND ANALYSIS PLANS FOR LANDFILLS AND RELATED AREAS

Two inactive landfills are presently located at Operable Unit (OU) 1086: Material Disposal Area (MDA)-N, near the fork in the road at building TA-15-40 and MDA-Z, on the southern mesa of TA-15 near G-site (Figure 8.5-1). Associated with MDA-N is an area just to the north: the site of buildings R-7 and R-1. When these two buildings were razed, much of the rubble is thought to have been placed in MDA-N; therefore, one sampling plan has been developed for all three potential release sites (PRSs).

Building material and rubble from PHERMEX were placed at the edge of the canyon at MDA-Z, which is now inactive.

A third area, Solid Waste Management Unit (SWMU) 15-008(b), consists of waste material from firing site SWMU 15-006(c) at R-44. This SWMU is considered in this chapter because its characteristics are similar to those of MDA-Z.

This chapter provides the description, data need and objectives, and sampling plans for the following MDAs and related PRSs:

Section 9.1

SWMU 15-007 (a)	Material disposal area (MDA-N)
Including	
AOC C-15-005	Site of removed building
AOC C-15-006	Site of removed building

Section 9.2

SWMU 15-007 (b)	Material disposal area (MDA-Z)

Section 9.3

SWMU 15-008 (b)	Waste material area

9.1 Landfill MDA-N, SWMU 15-007(a), and Related Areas

9.1.1 Site Description, History, and Potential Source Terms

MDA-N is described in the 1990 SWMU report (LANL 1990, 0145) as a pit containing remnants of several structures from R-site that had been exposed to explosives or chemical contamination. Its location is shown on Engineering Drawing ENG-R 102 (1965, 10-0042) and Figure 9.1-1. It is unknown whether radioactive contamination is present. If present it is unlikely to be major because buildings R-1 and R-7 were mainly used as offices. R-7 was control point of Firing Point C, while R-1 also contained a laboratory and shops.

Building TA-15-7 (ENG-R 130 1956, 10-0027), [Area of Concern (AOC) C-15-006] was the original control room and darkroom used in support of tests at Firing Points C and most likely D during the last half of the 1940s. Building TA-15-1 (AOC C-15-005) was the original laboratory and shop associated with these tests. By 1962 these buildings had been demolished and the remains disposed of according to engineering drawing ENG-R 5110 (1983, 10-0022). Unfortunately no information is available about the final destination of the rubble from these demolished buildings. MDA-N was opened in 1962 and may have been the recipient of these buildings. The pit is not described as being covered or revegetated. No other information is available concerning the material that was deposited in this landfill or its closing. An aerial photograph from 1965 indicates that regrading of the area occupied by buildings TA-15-1 (R-1) and TA-15-7 (R-7) and the covering of MDA-N had occurred prior to 1965.

Little is known about activities in these buildings that could have involved hazardous materials. Mercury was used and a small spill, which was subsequently cleaned up, is known to have occurred in building TA-15-7 (H Division 1953, 0624). Thorium contamination was found in building TA-15-1 (Buckland 1965, 10-0032) and was also cleaned up. Neither high explosives (HEs) nor uranium was handled in these two buildings. How the photographic solutions were disposed of is not recorded; they may have been poured into the septic tank (TA-15-80) connected to TA-15-1, although the darkroom was located in building TA-15-7. Building TA-15-7 had no known connection to the septic tank [SWMU 15-010(a)]. The aerial radiological survey (Fritzsche 1989, 10-0033) did not detect radioactive materials in this SWMU area (see Appendix H).

9.1.2 Potential Pathways and Receptors

Because no present day operational activities conducted at TA-15 involve MDA-N or the site of buildings R-1 and R-7 and because the landfill is covered by soil, there are no pathways of concern to operational on-site receptors.

There are two possible pathways for transport of the hazardous materials that may exist on the former location of buildings TA-15-1 and TA-15-7:

1. Mechanical resuspension into the air caused by intrusion of present-day occupational workers or future land users, or

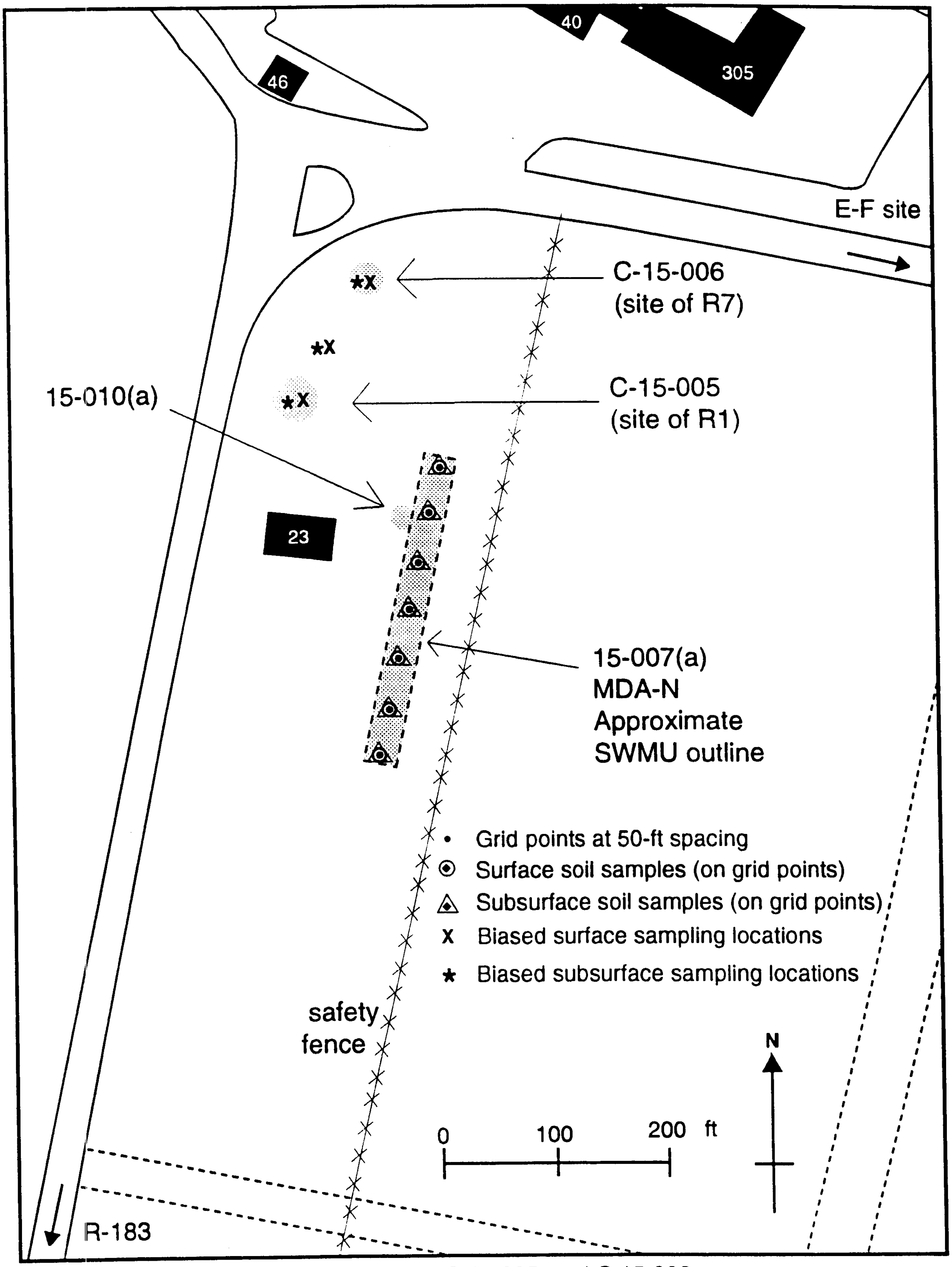


Figure 9.1-1 Sampling plan for MDA-N, C-15-005, and C-15-006.

2. Resuspension by wind action in the area while receptors are present, either now or in the future.

9.1.3 Data Needs

Data needs are as follows:

1. What are the boundaries of the landfill?
2. The major contaminants are postulated to be mercury, thorium, and silver. What is extent of these contaminants? Are they of concern to future land users?
3. What other contaminants may be present?
4. Have any of these contaminants migrated beyond the boundaries of the area being studied?

9.1.4 Sampling Plan

Before any sampling can be accomplished it is necessary to locate MDA-N accurately. We will accomplish this by surveying an area about 100 ft wide (W-E) and about 350 ft long (N-S), using a combination of the following: magnetometry, electromagnetic surveying, and resistive surveying. These methods will be field-tested in the area of MDA-N to determine which technique is most effective or if all methods will be utilized. These methods will delineate the boundaries of the disturbed soil and locate large metal objects. The fences and metal posts should and will be removed prior to magnetic or electromagnetic surveys. A 1986 survey (LANL 1986, 0965) failed in large measure because of its large grid spacing resulting in the magnetic data being biased. We plan a 1 m grid spacing.

In addition, a ground-based radiological survey (Appendix G) will be conducted over an area which also includes the sites of R-1 and R-7. Chemical site screening for metals (U, Pb, Hg, Th, Ag, and Be) will be conducted over the length of MDA-N as shown in Figure 9.1-1. Samples will be taken for chemical analysis as shown in Table 9.1-1. In addition, there will be spot tests for HEs and field screening for VOCs, (the latter for subsurface samples only).

Subsurface samples [standard operating procedures [(SOPs) 6.10 and 6.11] will be taken at the junction of the soil with tuff. The length of the core will be surveyed for radioactive hot spots. If any are located, samples will be taken at the locations and analyzed for metals, (U, Pb, Hg, Th, Ag, and Be), and HEs. As in the sampling plans in Chapter 8, no laboratory analyses for HEs will be conducted unless the field screening gives positive results. The subsurface samples will be analyzed for those VOCs tested for by the EPA SW 846 Method 8240 and enlarged upon in the LANL QAPjP. Laboratory analyses will include those semivolatile organic compounds (SVOCs) available by EPA SW 846 Method 8270.

A summary of the sampling plan is shown in Table 9.1-1. Some of the surface and subsurface samples collected will be subjected to full laboratory analysis. The sampling and analysis tables for MDA-N and related units are presented in Appendix I.

TABLE 9.1-1

SAMPLING PLAN FOR MDA-N SWMU 15-007 (a) AND AOC C-15-005 AND C-15-006

1×10^3 sq. ft

	FIELD SCREENING									LABORATORY ANALYSIS								
	Alpha Beta Gamma	Uranium	Thorium	Silver	Beryllium	Lead	Mercury	HEs	VOCs	Uranium	Thorium	Silver	Beryllium	Lead	Mercury	VOCs	SVOCs	
SWMU 15-007 (a) Surface Samples	7	7	7	7	7	7	7	7		4	4	4	4	4	4		4	
Subsurface Samples (24")	7	7	7	7	7	7	7	7	7	4	4	4	4	4	4	4	4	
C 15-005, C-15-006 Surface Samples	3	3	3	3	3	3	3			2	2	2	2	2	2		2	
Subsurface Samples (24")	3	3	3	3	3	3	3		3	2	2	2	2	2	2	2	2	
TOTALS	20	20	20	20	20	20	20	14	10	12	12	12	12	12	12	6	12	

9.1.5 Areas of Concern C-15-005 and C-15-006, and Residues from Buildings TA-15-1 and TA-15-7

As an adjunct to MDA-N, we are considering the site of building TA-15-1 and TA-15-7. Since the buildings are gone and the area regraded, it is unlikely any contamination remains. The regrading will have homogenized the soil here. The initial radiological survey will be undertaken in conjunction with MDA-N. We propose to field test three surface and three subsurface samples for metals (U, Pb, Hg, Ag, Th, and Be), HEs, and VOCs, as shown in Table 9.1-1 and Appendix I. These field tests will be followed by laboratory analyses (two samples) for the same analytes as well as for SVOCs. VOCs are only analyzed for subsurface samples. The set of VOCs and SVOCs available by the EPA methods listed in Table 4.7-3 will be tested for since the history of the AOCs is largely unknown.

9.2 MDA-Z; SWMU 15-007(b)

9.2.1 Site Description, History, and Potential Source Terms

MDA-Z [SWMU 15-007(b)] is an inactive disposal area located south of the side road leading to building TA-15-233 (Figure 8.5-1). This disposal area was used between 1965 and 1981 for construction debris, used concrete sandbags, steel blast matting from tests at PHERMEX, and other debris. Concrete-filled sandbags were piled as a retaining wall and other debris was then filled in behind (Figure 9.2-1). The debris is largely not covered with soil and is therefore exposed to rain and snowmelt. The aerial radiological survey of 1982 (Fritzsche 1989, 10-0033) did not detect radioactive contamination.

The 1989 environmental sampling study (DOE 1989, 0271) included samples from MDA-Z for various metals. The metals (Ba, Be, Cd, Cr, Cu, Pb, Ni, Ag, and Zn) were analyzed using inductively coupled plasma-mass spectrometry (level III/IV). For some of the metals, elevated readings were obtained when compared to the overall background levels for the Laboratory. For example, for beryllium, the five samples gave values ranging between 4.0 and 29.4 mg/kg while the average background level for the Laboratory is 2.4 mg/kg.

9.2.2 Potential Pathways and Receptors

The major potential pathway to receptors would occur by direct contact if the land reverts to uncontrolled use. Because the debris is uncovered, it would be of possible souvenir value to recreational users. A minor pathway is through air resuspension. Thus a sampling plan has been developed. After sampling, one possible course of action would be to carry out a voluntary corrective action (VCA) and to remove the debris to an approved disposal facility.

9.2.3 Data Needs

Since the materials came from PHERMEX, we know what the major contaminants are, but we do not know their distribution since the area appears to have been bulldozed and the major pieces of debris pushed from the top of the mesa.

The site will be surveyed for uranium, beryllium, lead, mercury, and volatile organic compounds (VOCs). In addition, because there are lingering doubts about the presence of HEs, spot tests for HEs are included.

9.2.4 Sampling Plan

As is shown in Figure 9.2-1, MDA-Z consists of large pieces of debris that have been pushed to the edge of the mesa top, probably bulldozed.

Figure 9.2-1 MDA-Z [15-007(b)] contains debris from PHERMEX (photograph taken July 1992).

Using the statistically based approach detailed in Chapter 4 we will take 14 surface samples and 14 subsurface (24 in. or tuff/soil interface). This number will confer 95% confidence that contamination will not be missed. The 14 samples will be obtained in a biased fashion (subject to change in location depending on the results of field screening) and, as shown in Figure 9.2-2 will be obtained along the total edge of the debris at 50 ft intervals, at the edge of the canyon, and down the center of the debris.

After site screening, fifty percent of the surface and subsurface samples collected will be sent for laboratory analysis. The location and depth of these samples will be defined after the chemical site screening, and the locations of the samples may be modified if large, solid pieces of debris occur at grid points.

The overall sample plan is summarized in Table 9.2-1, and the sampling and analysis tables presented in Appendix I.

The set of VOCs and SVOCs available by the EPA methods listed in Table 4.7-3 will be tested for since the detailed history of this MDA is unknown.

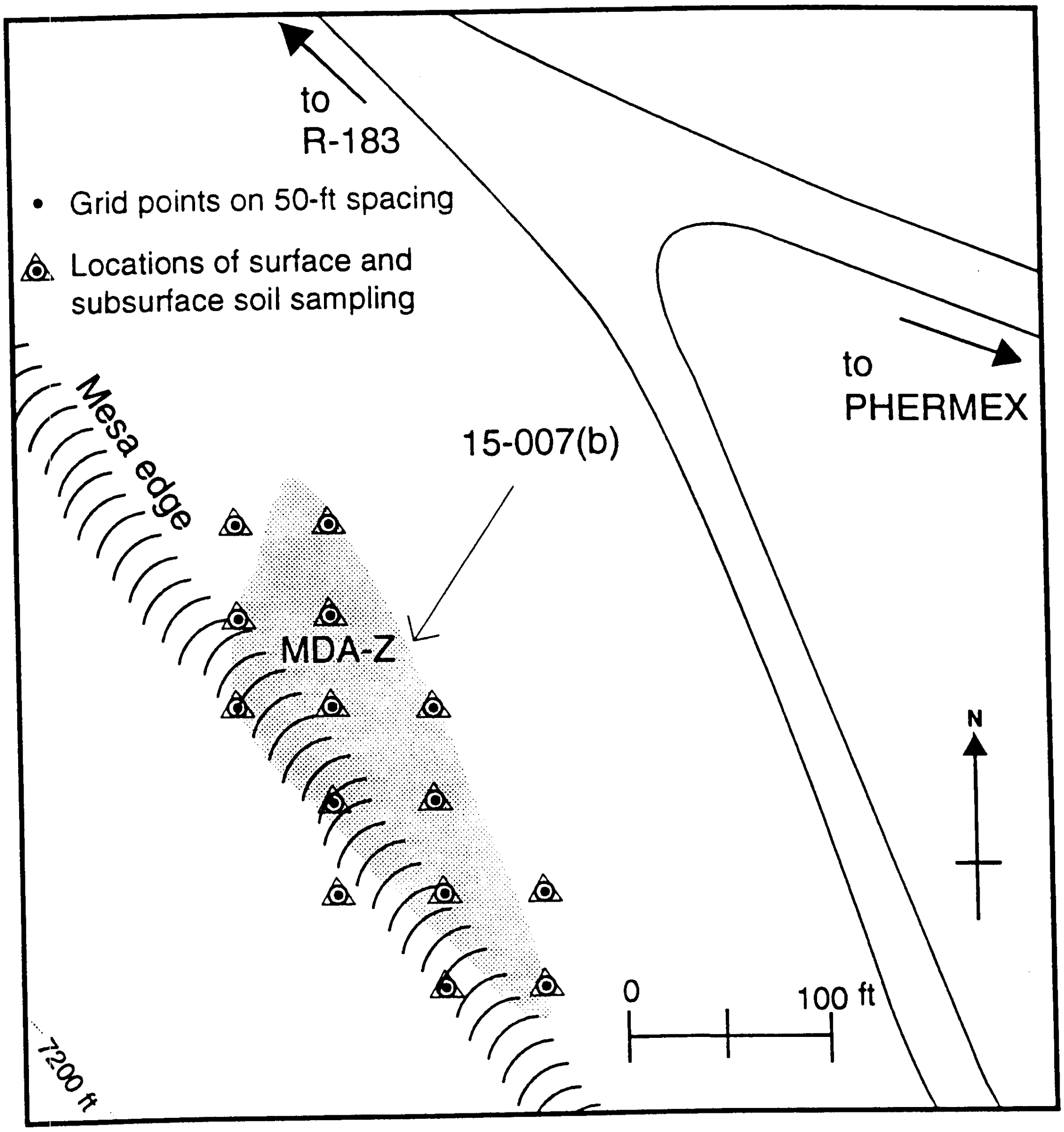


Figure 9.2-2 Sampling plan for MDA-Z [15-007(b)].

TABLE 9.2-1 SAMPLING PLAN FOR MDA-Z [SWMU 15-007 (b)] 2×10^4 sq. ft.	FIELD SCREENING							LABORATORY ANALYSIS					
	Alpha Beta Gamma	Uranium	Beryllium	Lead	Mercury	HEs	VOCs	Uranium	Beryllium	Lead	Mercury	VOCs	SVOCs
SWMU 15-007 (b)													
Surface Samples	14	14	14	14	14	14		7	7	7	7		7
Subsurface Samples (24")	14	14	1 4	14	14	14	14	7	7	7	7	7	7
TOTALS	28	28	28	28	28	28	14	14	14	14	14	7	14

9.3 Disposal Area SWMU 15-008(b) at R-44

9.3.1 Site Description, History, and Potential Source Terms

Disposal area SWMU 15-008(b) is associated with the active firing site R-44 (Figure 6.3-1).

R-44 is currently the third most extensively used firing site at TA-15 and was named after the control room at this site. This firing site was built in 1951 and was used extensively from 1945 through 1978 for diagnostic tests of weapon components. After the inception of PHERMEX and Ector, this site was used infrequently but is still kept in an active status. The diagnostic capabilities at R-44 are different from and extremely modest compared with those at PHERMEX and Ector.

R-44 is located on a relatively open flat area on a narrow mesa. Consequently, some debris from the explosions has been scattered through the air into the canyons on either side of the firing site. In addition, a shelf of soil and debris [SWMU 15-008(b)] (Figure 9.3-1) was made on the north side of the firing site when remnants and debris from tests were pushed aside.

The ground based radiological survey of 1991 (Schlapper 1991, 10-0009) found small pieces of uranium metal on the R-44 firing site area. Measured exposure rates ranged from 50 mR/h (again due to lumps of depleted uranium (DU) on contact to as low as 0.1 mR/h (background values). The area was partially cleaned up.

A more extensive sampling effort was undertaken in the Idaho National Engineering Laboratory (INEL) Environmental Survey of 1987 (DOE 1989, 0271). Samples were taken at four radii from the center of the firing site (10, 100, 250, and 450 ft). None of the samples contained detectable quantities of HEs. Lead, beryllium, and uranium essentially decreased with distance from the center of this firing point. Lead decreased from 513 mg/kg in the center of the test area to 12 mg/kg at the greatest radius. Beryllium decreased from 16.3 mg/kg at the center to 0.6 mg/kg at the greatest radius. Uranium-238 also decreased with distance from the center (725 to 45 mg/kg).

Thus, the potential source terms on the shelf of soil and debris [SWMU 15-008(b)] are uranium, lead, and beryllium with the possibility of residual HE. Note that the probable contaminants at this site are the same as those to be evaluated at other firing sites within OU 1086.

9.3.2 Sampling Plan

As is shown in Figure 9.3-1, SWMU 15-008(b) consists of large pieces of debris pushed to the edge of the mesa top. Figure 9.3-2 shows a schematic of the sampling plan.

Because the materials in the debris pile consist of soil and debris generated from testing at the R-44 firing site (debris is from the actual firing point), we determined that at least 80% of the materials is contaminated. Thus, two

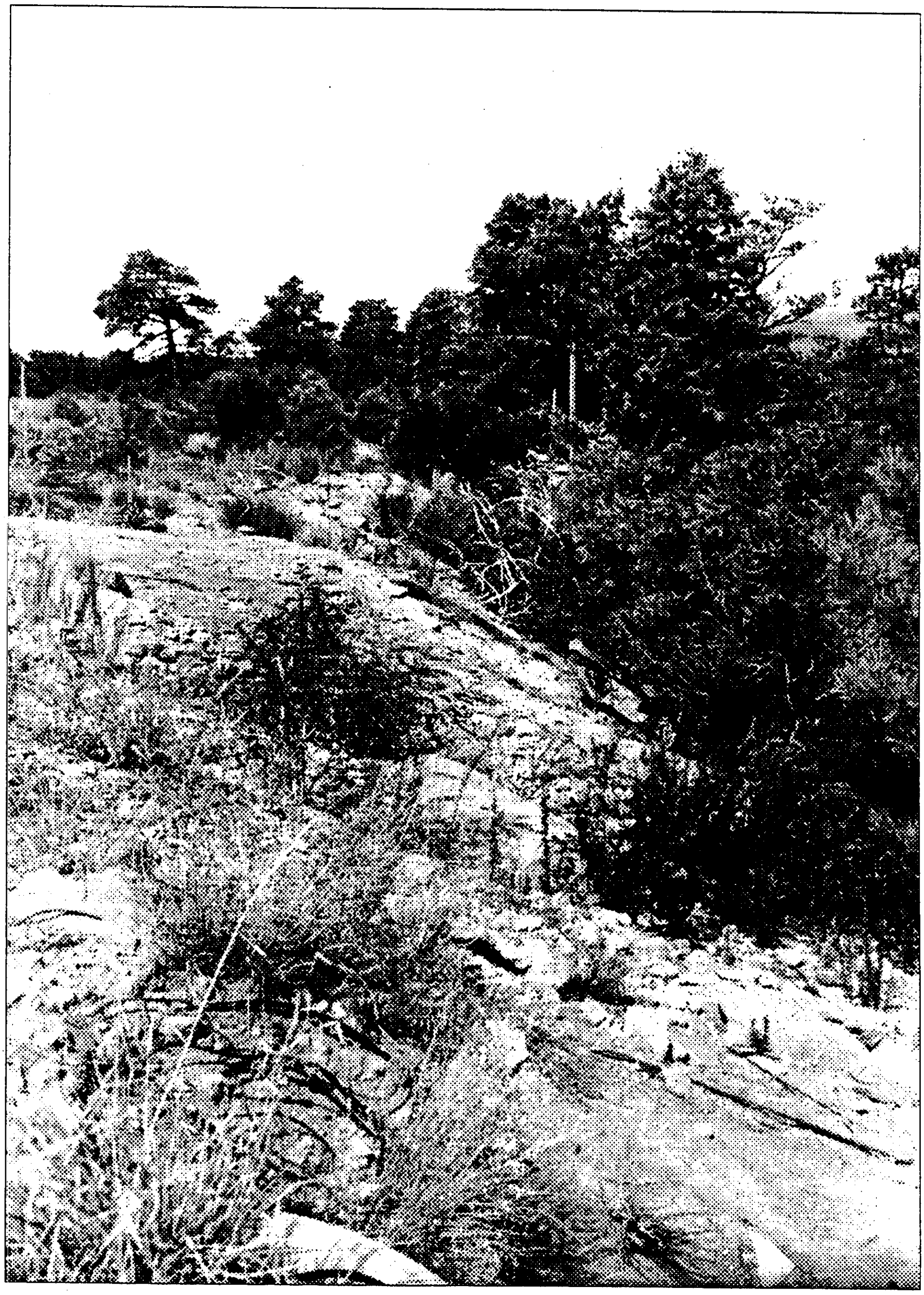


Figure 9.3-1 Shelf of debris at Firing Site R-44 (photograph taken July 1992).

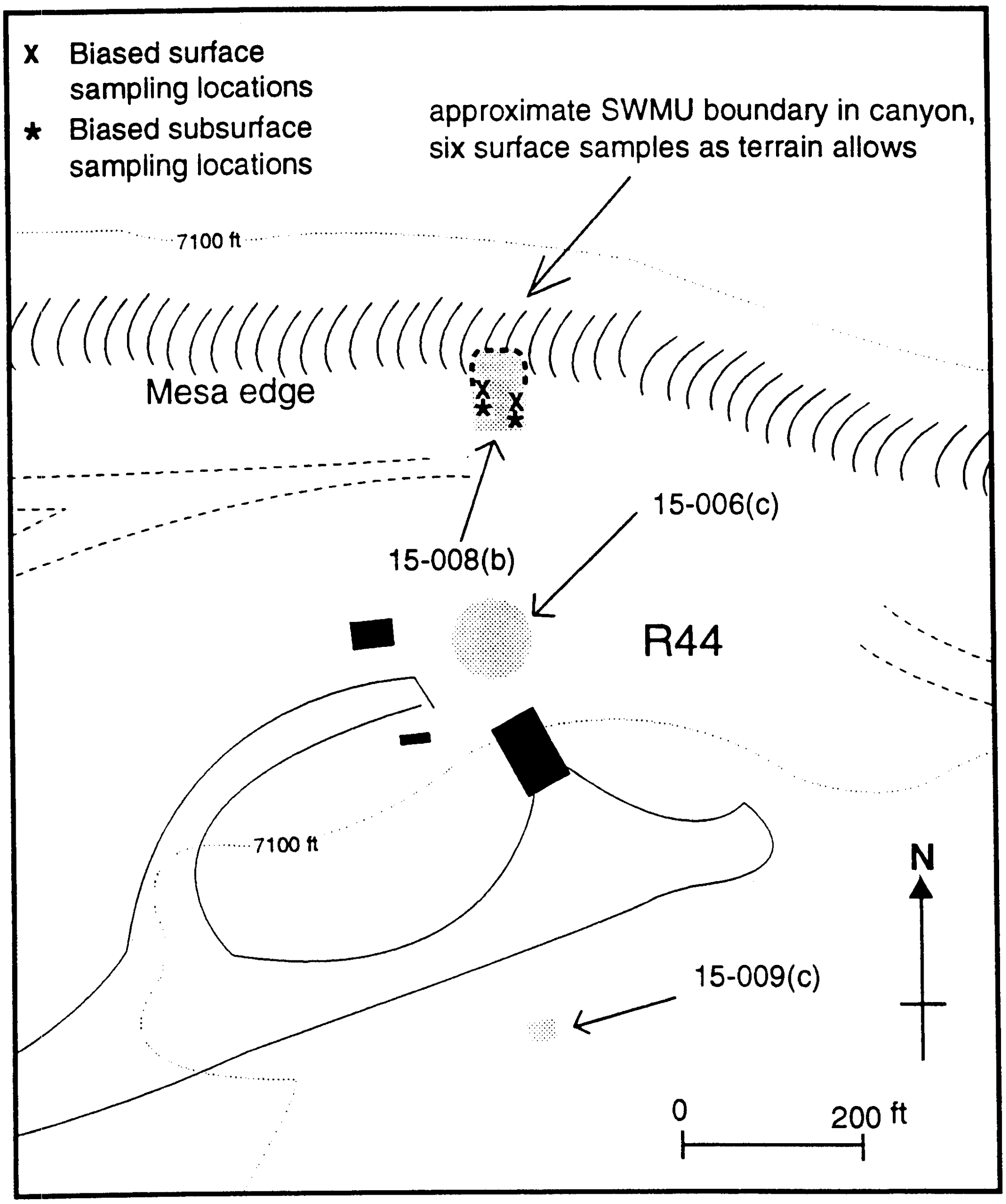


Figure 9.3-2 Site diagram for R-44 and sampling plan for SWMU 15-008(b).

samples (determined from the statistically based sampling strategy presented in Chapter 4) of the debris pile should suffice to confirm the existing level of contamination. The two samples will be located in the debris pile at the most likely contaminated portions (i.e., the locations will be biased). Soil from the pile as well as the subsurface soil beneath the pile will be sampled.

Because some of the material in the debris pile was pushed over the rim of the canyon, an additional six surface samples will be taken from within the canyon at points defined by their accessibility. The location of the samples will be biased according to the results of a radiological survey in accessible areas within the canyon.

The plan consists of the following steps:

- site survey
- radiological survey
- chemical site screening survey
- surface sampling
- subsurface sampling

Field screening (radiological, metals, and HEs) will be accomplished as shown in Table 9.3-1.

Because of the small sample size, all surface and subsurface samples collected from the debris pile will be sent for laboratory analysis. The sampling plan is summarized in Table 9.3-1 and the sampling and analysis tables presented in Appendix I.

TABLE 9.3-1

SAMPLING PLAN FOR SWMU 15-008 (b)

1.5 x 10^3 sq. ft.

	FIELD SCREENING					LABORATORY ANALYSIS		
	Alpha Beta Gamma	Uranium	Beryllium	Lead	HEs	Uranium	Beryllium	Lead
SWMU 15-008 (b)								
Surface Samples	2	2	2	2	2	2	2	2
Subsurface Samples (24")	2	2	2	2	2	2	2	2
Surface Sampling in Canyon	6	6	6	6	6			
TOTALS	10	10	10	10	10	4	4	4

CHAPTER 9 REFERENCES

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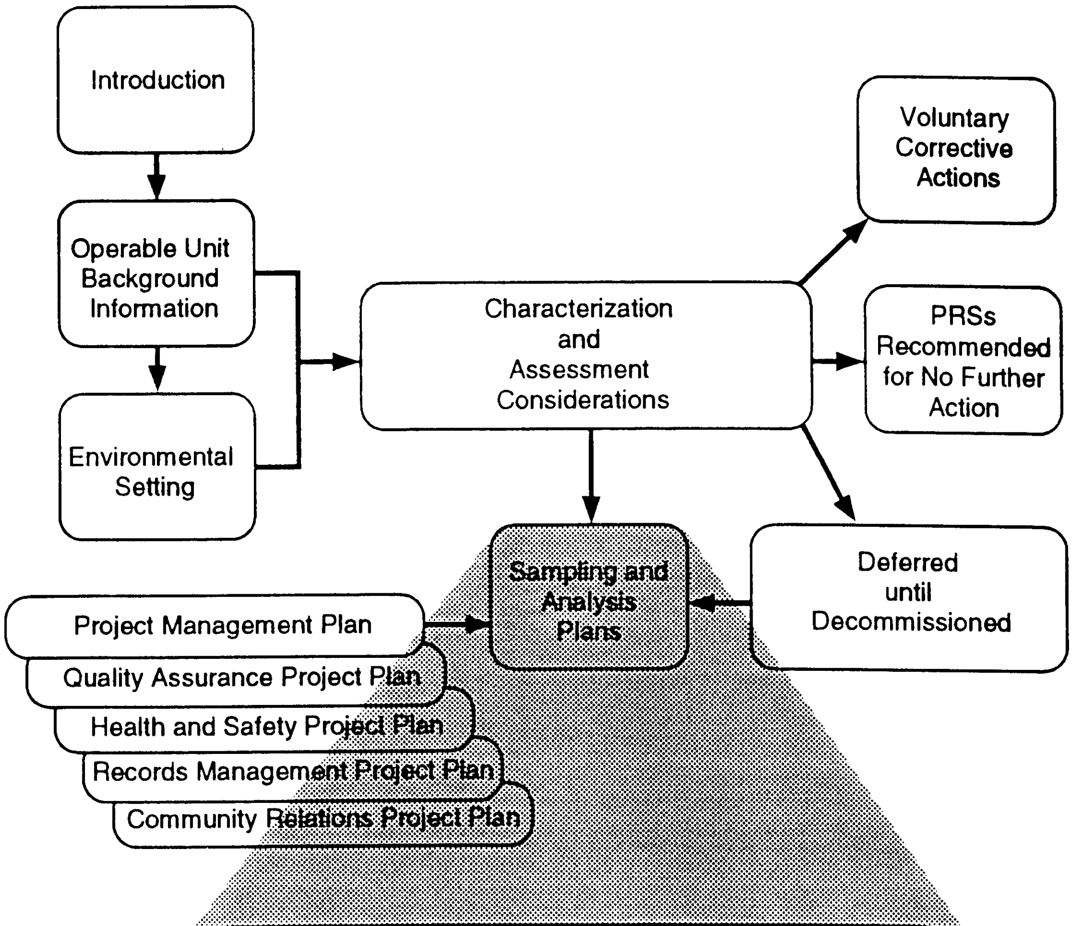
CHAPTER 10



Sampling and Analysis Plans

- Miscellaneous Potential Release Sites

10.0 MISCELLANEOUS POTENTIAL RELEASE SITES WITH SAMPLING PLANS

There are a number of potential release sites (PRSs) located in Operable Unit (OU) 1086 that do not fit into the categories of no further action (NFA), deferred until decommissioned, inactive firing sites, and landfills. These PRSs have been collected into this miscellaneous section and are listed in Table 10.0-1. Throughout this chapter, if all the field screening samples show contamination below screening action levels (SALs), then the only laboratory analysis which is recommended is for semi volatile organic compounds (SVOCs). If the samples show significant contamination, then some of the samples will be sent for further analysis.

TABLE 10.0-1

MISCELLANEOUS POTENTIAL RELEASE SITES WITH SAMPLING PLANS

Section	Area	PRS	Description
10.1	The Hollow	SWMU 15-011(c) }	Outfall
		SWMU 15-011(b) }	Drainline
		SWMU 15-014(i) }	Sump
		SWMU 15-014(j) }	Drain
		AOC C-15-007 }	Stained soil
		SWMU 15-011(a)	Sump removed
		SWMU 15-014(k)	Drainline
		AOC C 15-010	Site of removed inactive tank
10.2	R-183	SWMU 15-012(b) }	Operational release
		SWMU 15-009(j) }	Active septic system
		SWMU 15-014(a) }	Outfall
		SWMU 15-014(b) }	Outfall
		SWMU 15-009(f)	Active septic system
		SWMU 15-009(k)	Active septic system
		SWMU 15-005(b)	Container Storage area
10.2	Firing Site C	SWMU 15-005(c)	Container storage area
10.3	R-40	SWMU 15-014(h)	Outfall (2)
		SWMU 15-010(b)	Inactive septic system

10.1 Potential Release Sites at The Hollow

10.1.1 Site Description

A series of buildings (TA-15-20, TA-15-203, TA-15-50, and TA-15-194) (Figure 10.1-1), connected by roof structures, has been assembled over a period of time since 1949 in an area called The Hollow. This area is south of TA-15-40, the main office building for TA-15, and west of the road running north and south connecting the firing site areas of the two mesas on which TA-15 is located. Related to those buildings and the surrounding area are a number of PRSs involving septic tanks, sumps, drainage ditches, outfalls, and an underground storage tank.

This series of connected buildings, beginning with TA-15-20 in 1949, has had varied uses as assembly buildings, laboratories, and shops, and these buildings are still actively used by M-4, the Laboratory's Hydrodynamics group. As shown by routine monitoring, most of the PRSs are not currently hazardous to occupational workers. Because of past practices, eight of the PRSs are scheduled for characterization as listed in Table 10.0-1.

10.1.2 History and Potential Source Terms

The 1990 SWMU report (LANL 1990, 0145) states that a sump may have been located at the edge of Cañon de Valle, which received acid waste from drains in building TA-15-50 (Figure 10.1-1), or the waste may have been discharged directly to Cañon de Valle. No evidence of any such sump [SWMU 15-011(c)] has been located (Francis 1992, 10-0002). We conclude that the acid wastes where discharged directly into Cañon de Valle rather than being emptied into a sump.

In the 1960s, building TA-15-194 had a vapor degreaser and strip tanks (LASL 1961, 10-0039). In addition to the degreaser, solutions containing sulfuric acid, chromates, and/or hydrochloric acid may have been emptied into the drain line serving this building [SWMU-011(b)], which then emptied into an outfall at the edge of Water Canyon. In 1978 a 4-ft-diameter by 50-ft-deep seepage pit [SWMU 15-014(i)] was installed in this drain line and the outfall was plugged. The vapor degreaser has been removed (approximately 1987) and only a sink is now connected to the drain line and seepage pit. A pipe from the back of building TA-15-203 empties into the main drainage channel at 15-014(j) forming another point at which contaminants discharge.

The northern and eastern ends of The Hollow (immediately behind the buildings) rises very steeply The road from the south curves around a steep downward gradient. To the west the ground drops off sharply as a canyon wall. Because of this topography, all effluents in the drains and outfalls (SWMU 15-0011(b), 15-014(i), and 15-014(j) are naturally funneled to SWMU 15-011(c). This last SWMU is situated just before the canyon wall drop off.

SWMU 15-011(c) is therefore considered as being located at the edge of the mesa top where all the outfalls from operations carried out within the buildings

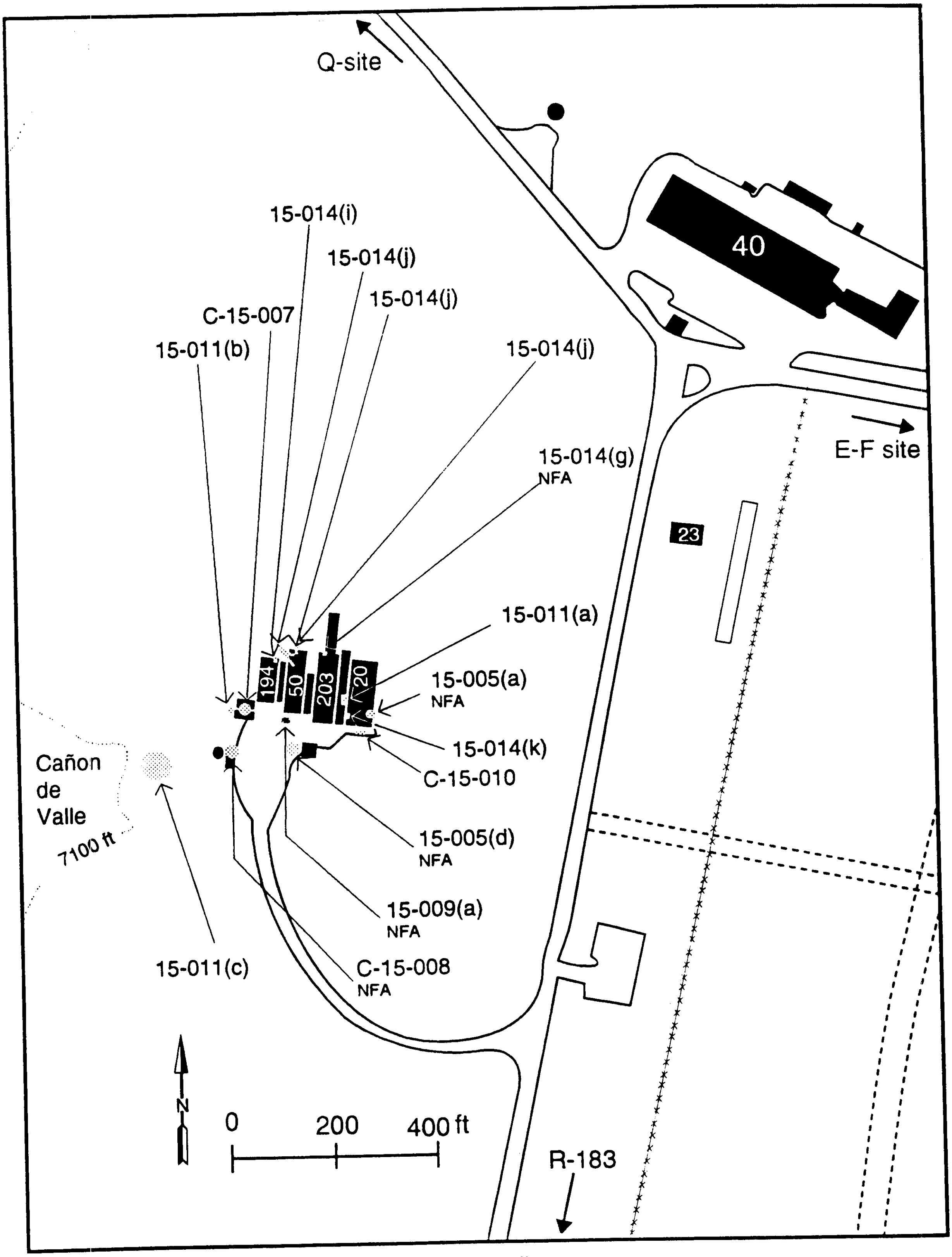


Figure 10.1-1 Buildings and PRSs in The Hollow.

in The Hollow combine to flow into Cañon de Valle. Sampling (Section 10.1.5.1) is considered for all five PRSs which are north and west of the buildings in The Hollow [15-011(c) and (b), 15-014(i) and (j), and C-15-007] together since they are all part of the same drainage. The additional PRS at The Hollow are considered in Section 10.1.5.2.

Stained soil (C-15-007), outside of the west corner of building TA-15-194 was noted during the ER site reconnaissance visit in 1988 (LANL 1989a, 0861; LANL 1989b, 0862; LANL1989c, 0863:). The area is now covered by a metal transportainer (transportable container) designated TA-15-372; thus, this Area of Concern (AOC), if present, is not of immediate hazard to occupational workers.

Hazardous materials that may be in these PRSs comprise acid residues (from sulfuric and chromic acids) and organics from a vapor degreaser. In addition, toxic metals (uranium, beryllium, and lead) may be present. All these hazards will naturally be funneled to SWMU 15-011(c).

10.1.3 Potential Pathways and Receptors

Figure 10.1-2 is a photograph from across the canyon toward the canyon wall of Cañon de Valle. The ditch from buildings in The Hollow empties at the location indicated by the arrow. It is evident from this photograph that any hazardous constituents present would not be a health risk to present-day occupational workers because the effluents drain down the steep side of the canyon. There are no occupational activities that could reasonably be carried out at this SWMU. The 20 yrs during which dilution by rain and snowmelt have diffused into sediments and diluted them, as well as the long distance to any receptors have probably reduced the hazard of this pathway to receptors.

The only realistic pathway to a receptor is represented by the accumulation of hazardous materials in a catch basin along the steep outfall and at the canyon below. If the land should revert to public recreational use and if digging should commence in the catch basin areas, then receptors in the area could be exposed.

10.1.4 Data Needs

To decide whether this SWMU represents a health-based risk to future receptors involved in realistic future land uses (Section 4.3), we need to determine if there are contaminants of concern (COCs) at the outfall and in catch basins below this outfall that are of concentrations at or above screening action levels.

10.1.5 Sampling Plans

10.1.5.1 Surface Drainage Sampling Plan for The Hollow

A diagram of the aggregate sampling plan is shown in Figure 10.1-3 and a photograph of the area [15-011(c)] is shown in Figure 10.1-4 at SWMU 15-011(c), where two drainage channels come together, one from the front

Figure 10.1-2 Outfalls from buildings in The Hollow, photographed in July 1992. The photograph is taken across Cañon de Valle looking northeast up toward The Hollow in the top right quadrant of the photograph.

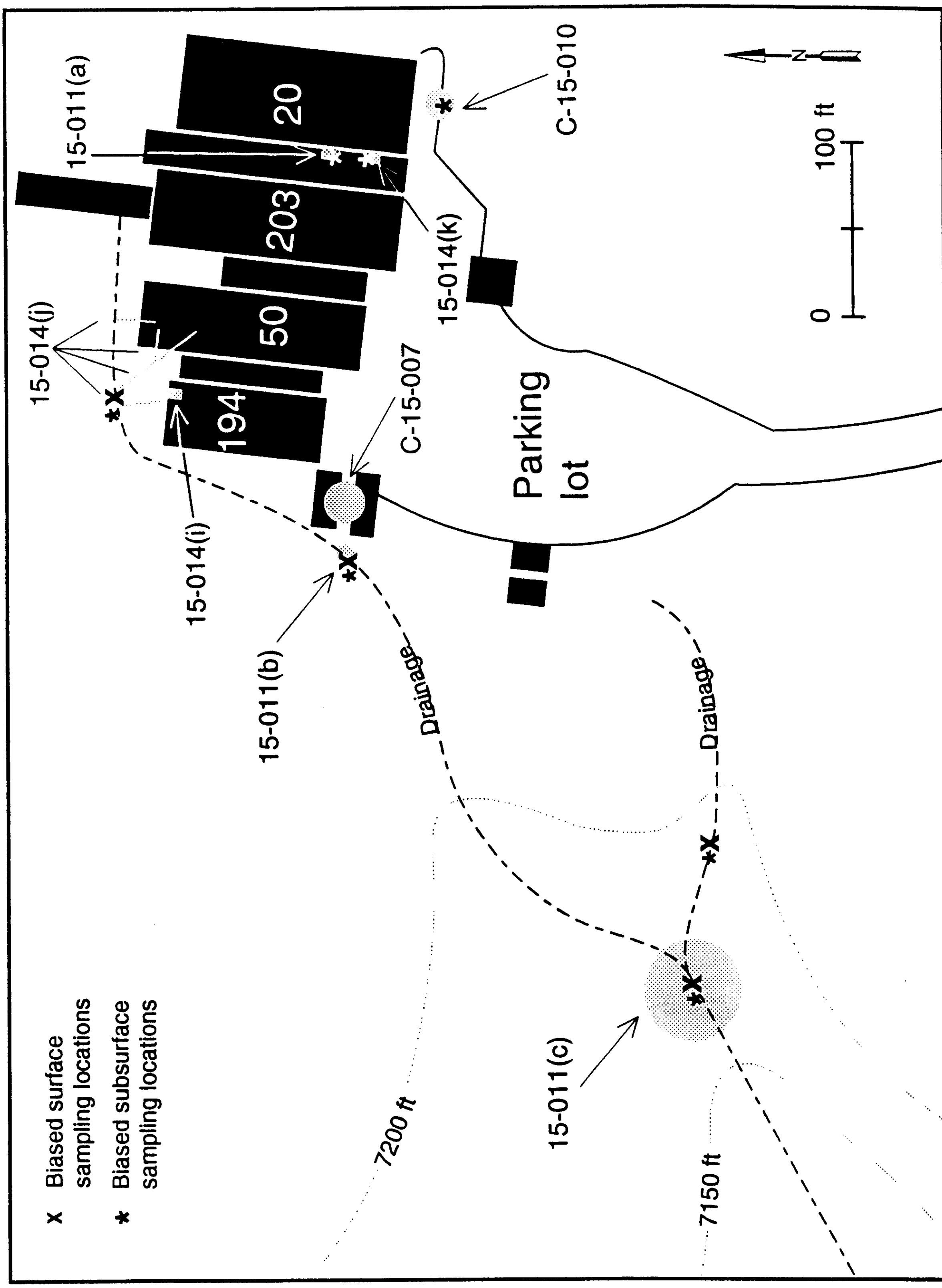


Figure 10.1-3 Site diagram and sampling plan for PRSs in The Hollow.

Figure 10.1-4 View just above SWMU 15-011(c) showing two drainage channels (arrows), which unite just below the photograph (photograph taken February 5, 1993).

parking lot and one from the rear of the buildings. Four surface and four subsurface soil samples will be taken. These will be field screened for radioactivity, metals (Pb and Cr), and high explosives (HEs). The subsurface samples will be screened also for volatile organic compounds (VOCs). If any of these results are above the natural geochemical background levels, all will be sent for lab analyses. If at the background levels, only one sample will be sent.

The samples will be tested for those organic compounds which are identified by EPA methods 8270 and 8240.

A summary of the sample plan for surface drainage from The Hollow is presented in Table 10.1-1 and the sampling and analysis tables are given in Appendix I.

10.1.5.2 PRSs East Side of The Hollow

During the earlier years of use of building TA-15-20, trench drains [SWMU-014(k)] emptied into manholes TA-15-150 and TA-25-151, that were connected to a sump [SWMU-011(a)], which in turn drained to an outfall at the edge of Water Canyon near the outfall [SWMU-011(c)] listed above (Francis 1992, 10-0002). Manhole TA-15-150 and the sump were removed, and the drain line to the outfall was plugged. However, manhole TA-15-151 is now connected to the septic tank TA-15-51 described above.

An inactive underground fuel storage tank AOC C-15-010 (structure designation is TA-15-52) was located 15 ft south of the southwest corner of building TA-15-20. This tank was removed in 1989.

We propose to take two separate subsurface samples at these three PRSs (SWMU 15-011(a), SWMU 15-014(k) and AOC C 15-010) and analyze them for the same constituents as at the other PRSs at The Hollow. The sampling plan is shown in Table 10.1-1 and the sampling analysis tables are given in Appendix I.

TABLE 10.1-1
SUMMARY OF SAMPLING PLAN FOR PRSs AT THE HOLLOW

	FIELD SCREENING							LABORATORY ANALYSES					
	Alpha, Beta, Gamma	Uranium	Beryllium	Lead	Chromium	HEs	VOCs	Uranium	Beryllium	Lead	Chromium	VOCs	SVOCs
SWMU 15-011 (b), SWMU 15-011(c), SWMU 15-014 (i), SWMU 15-014 (j), AOC C 15-007													
Surface Samples	4	4	4	4	4	4		4	4	4	4		4
Subsurface Samples	4	4	4	4	4		4	4	4	4	4	4	4
SWMU 15-011 (a) Subsurface Samples 24"	2	2	2	2	2		2	2	2	2	2	2	2
SWMU 15-014 (k) Subsurface Samples 24"	2	2	2	2	2		2	2	2	2	2	2	2
AOC C 15-010 Subsurface Samples 24"	2	2	2	2	2		2	2	2	2	2	2	2
TOTALS	14	14	14	14	14	4	10	14	14	14	14	10	14

10.2 Potential Release Sites at R-183

These are shown in Figure 10.2.1 and listed in Table 10.0-1.

10.2.1 SWMU 15-012(b); Operational Release

Both the Laboratory SWMU report (LANL 1990, 0145) and the Comprehensive Environmental Assessment and Response Program (CEARP) report (DOE 1987, 0264) state that contaminated vessels were washed out with water in a bermed area near building TA-15-285 (Figure 10.2-2) [SWMU 15-012(b)].

10.2.1.1 Site Description, History, and Potential Source Term

Some explosive testing at TA-15 has been carried out inside heavy-walled steel spheres (diameter 6 ft). Any debris from the explosion was therefore, contained within the spheres. The debris was cleaned from these spheres just south of building TA-15-285 where it was deposited. The debris would be similar to that found with noncontained explosions: uranium, beryllium, and lead. The washed spheres were stored in the Boneyard discussed in Section 8.5 (SWMU 15-001). The location is well known because the spheres were suspended from a boom truck when they were cleaned. This boom truck remained on the macadam parking area northeast of TA-15-285, with the suspended spheres to the south east of building TA-15-285 (Figure 10.2-1).

This area has been surveyed with hand-held radiation meters and has been shown to be radioactively contaminated (Veverka 1988, 10-0011; Schlapper 1991, 10-0009) but contaminated levels have not been quantified.

10.2.1.2 Potential Pathways and Receptors

As for firing sites, pathways to occupational workers and future recreational receptors primarily include resuspension mechanisms and direct radiation exposure if the concentration of the hazardous materials is sufficiently high.

10.2.1.3 Data Needs

In order to determine whether this SWMU is of concern, we will measure the extent, concentration, and depth profile of uranium, beryllium, and lead. We will also check for HEs.

10.2.1.4 Sampling Plan

A 150-ft by 100-ft area southeast of TA-15-285 and bounded on the north by the macadam parking lot and roads is expected to be contaminated (Figure 10.2-3).

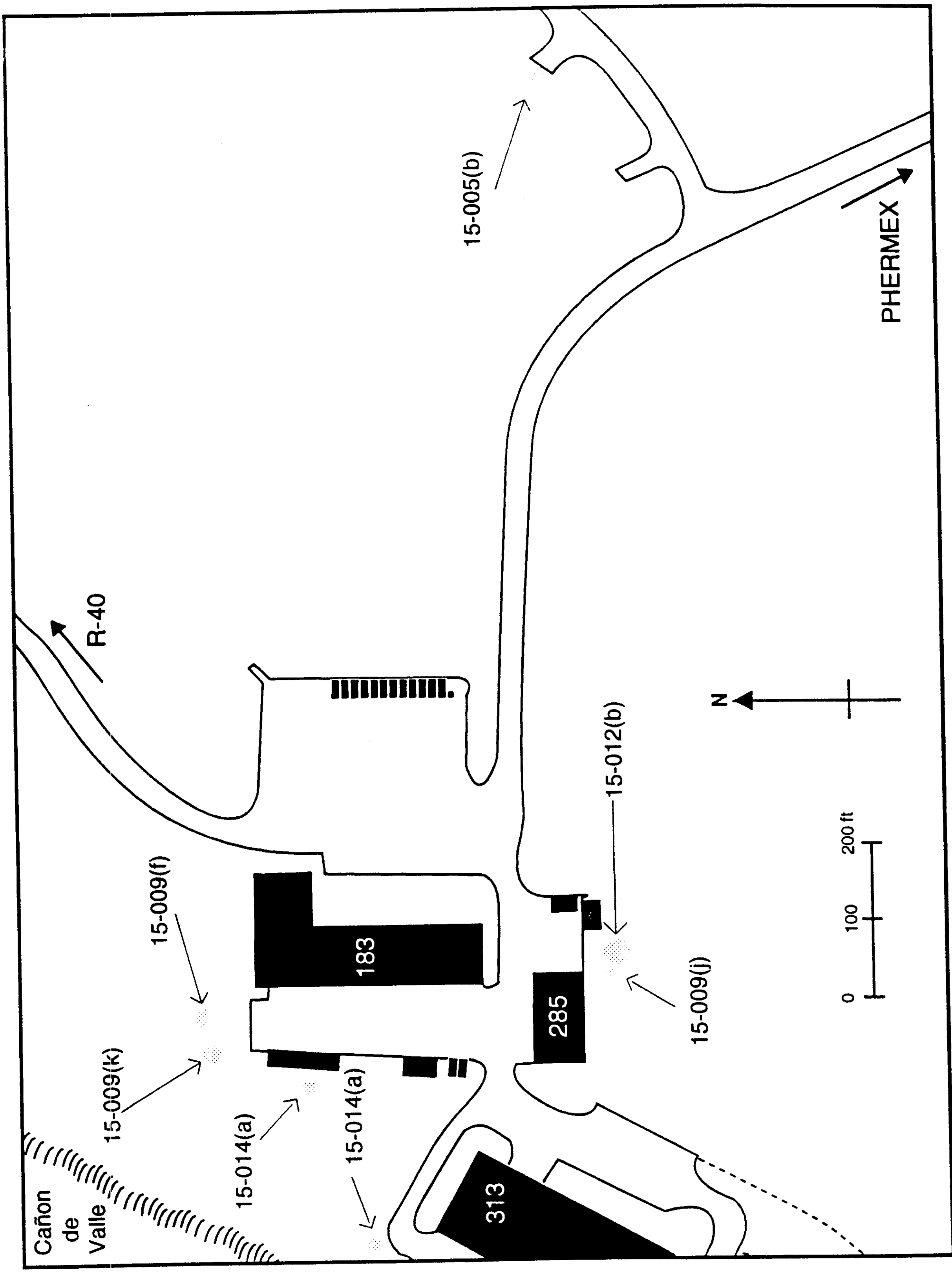


Figure 10.2-1 Diagram of R-183 showing location of PRSs with sampling plans in chapter 10.

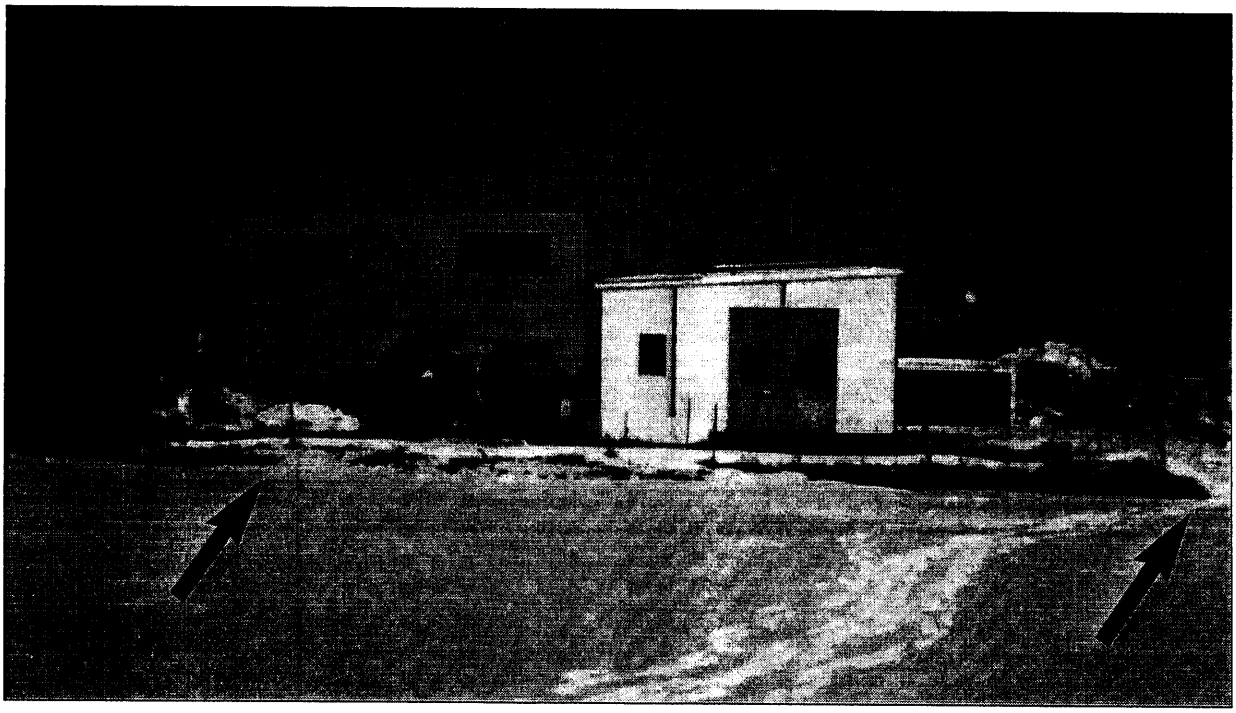


Figure 10.2-2 SWMU 15-012(b). Wash area at R-183, behind fence running east-west across middle of photograph. Arrows indicates ends of the fence. (Photograph taken due north February 5, 1993.)

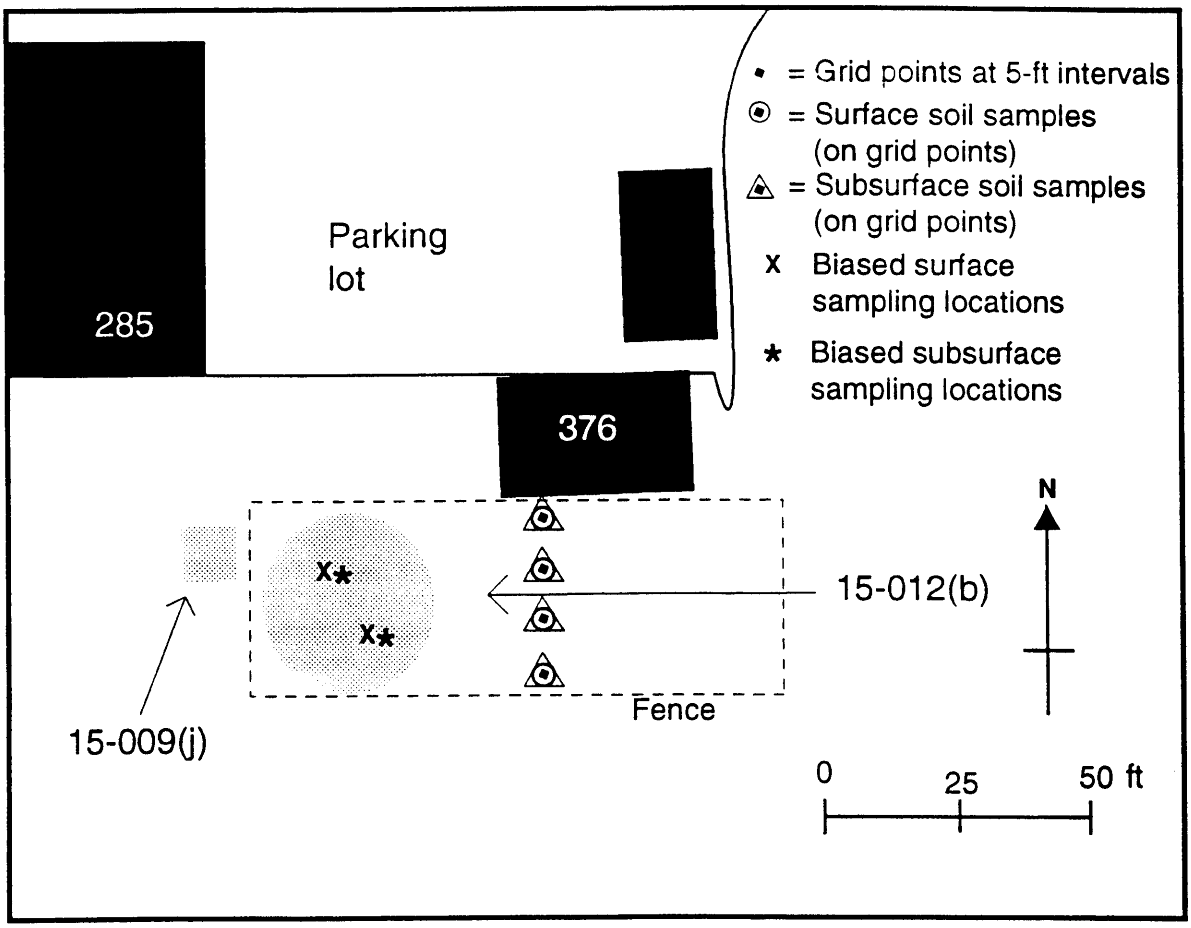


Figure 10.2-3 Site diagram for R-183 showing sampling plan for SWMU 15-012(b) .

Since the ground has a gentle gradient to the east, surface and subsurface soil sampling will emphasize the area to the east of the wash area where contaminants would be expected to pool and settle. A radiological survey will be conducted using the EG&G truck-mounted gamma detector or equivalent hand held equipment. Two samples of the source area will be collected to determine the level of the contamination. Four additional sample locations will be equally spaced approximately 25 ft east of the visible eastern boundary of SWMU 15-012(b). Both surface and subsurface (at a 2 ft depth) samples will be collected at all sample locations.

Field screening will determine levels of uranium, lead, beryllium, and HEs. Subsurface samples to the 2-ft depth or tuff interface will be taken at each surface soil sampling location. These subsurface samples will, in turn, be sampled at the 2-ft depth or at the tuff interface for further analysis of uranium, beryllium, lead, and HEs.

Because the active septic system SWMU 15-009(j) is in the area of sampling for 15-012(b), we propose to take two sludge samples and to field test for radioactivity uranium, lead, beryllium, and HEs. Two samples will be sent for chemical analyses.

A summary of the sampling plan is shown in Table 10.2-1 and the sampling and analysis tables presented in Appendix I.

10.2.2 SWMUs 15-014(a), 15-014(b); Outfalls from Building TA-15-183

10.2.2.1 Site Description, History, and Potential Source Terms

SWMU 15-014(a) is an outfall from drains located in building TA-15-183 that have been in use since 1961. This outfall is permitted under Environmental Protection Agency (EPA) permit number 06A 123 for present use. Before the outfall was permitted by the EPA, its effluent included photographic wastes, making silver and organics the potentially hazardous materials at this outfall. A new drain was installed in 1987 which had the same path as the old drain. The exit of this is at SWMU 15-014(a). The path of the effluents to the canyon is evidenced by increased vegetation.

SWMU 15-014(b), shown in Figure 10.2-4, consists of two separate outfalls from drains from building TA-15-183, which run under the trailer west of building 183. The separate outfalls join together and the location has been designated as outfall 15-183-OPN-1 by the Santa Fe Engineering, Ltd. report (Santa Fe Engineering, Ltd. 1991, 10-0037). It drains 13 floor drains, five sinks, and a water fountain. It leaves building TA-15-183 near the northwest corner and empties into Cañon de Valle. Because effluents from the same photo lab descri3bed for SWMU 15-014(a) may be present here, samples will be taken for the aggregated SWMUs 15-014(a) and (b) as shown in Figure 10.2-5. Currently these drains are simply used to drain the parking lots.

**TABLE 10.2-1
SAMPLE PLAN FOR SWMU 15-012 (b)
AND SWMU 15-009 (j)**

	FIELD SCREENING					LABORATORY ANALYSES			
	Alpha, Beta, Gamma	Uranium	Beryllium	Lead	HEs	Uranium	Beryllium	Lead	HEs
SWMU 15-012 (b)									
Surface Samples	6	6	6	6	6	3	3	3	
Subsurface Samples	6	6	6	6	6	3	3	3	
SWMU 15-009 (j)									
Sludge	2	2	2	2	2	2	2	2	2
TOTALS	14	14	14	14	14	8	8	8	2

Figure 10.2-4 SWMU 15-014(b). Outfalls from building R-183. Arrows indicate sampling points. (Photograph, looking north, taken February 5, 1993.)

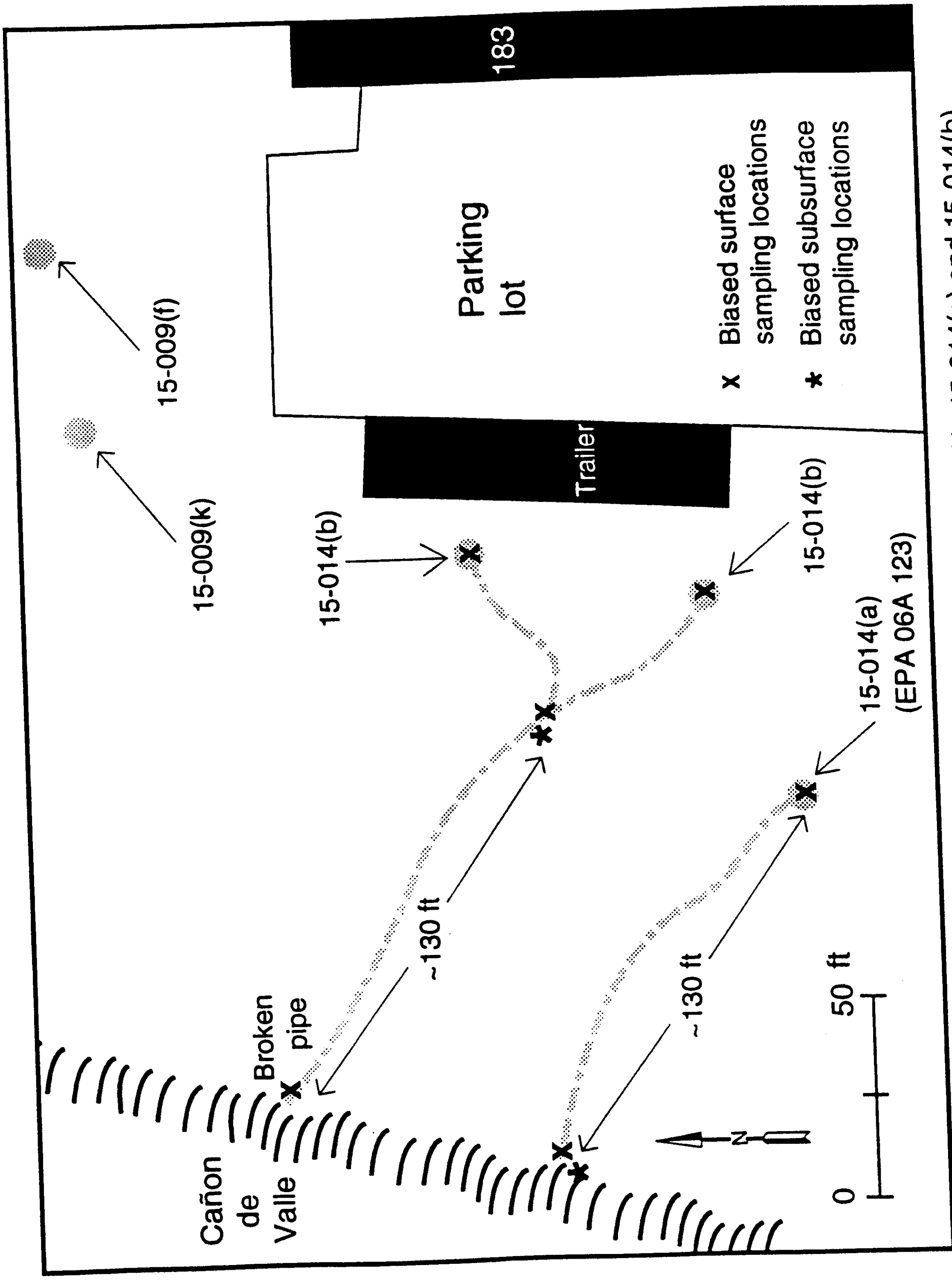


Figure 10.2-5 Diagram for location and sampling plan for SWMUs 15-014(a) and 15-014(b).

10.2.2.2 Potential Pathway and Receptors

Because of the isolation of this area and the projected future land use (Section 4.2), the pathways to receptors may be of concern only if actual digging were to be done in an area possibly containing contamination by occupational workers or by future recreational users.

10.2.2.3 Data Needs

The concentrations of silver compounds and associated photographic organic compounds (including glutaraldehyde and hydroquinone need to be determined at the discharge point along the water flow path away from this outfall.

10.2.2.4 Sampling Plan

Sediment samples to 6-in. depth will be taken at the six locations marked on Figure 10.2-5. In addition, two subsurface samples to depths of 2 ft (or soil tuff interface) will be taken at two locations. These samples will be screened for silver and organics and sent out for laboratory analyses, as shown in Table 10.2-3 and Appendix I. The organic compounds analyzed will be defined by the EPA methods listed in Table 4.7-3.

10.2.3 Additional Potential Release Sites at R-183

10.2.3.1 SWMUs 15-009(f), (k); Active Septic Systems

The septic systems carry only sanitary wastes from Laboratory buildings. therefore the likelihood of any significant quantities of hazardous materials being placed in the septic system is low and pathways to receptors are minimal; see Table 10.2-5. The tanks are registered with the New Mexico Environmental Division (NMED) as "unpermitted individual liquid waste system," as shown in Chapter 2, Table 2.5-1. The septic tanks are all constructed of reinforced concrete. At one time the effluent from all of the septic tanks either went to an outfall or else a leach field. In the 1970s all but one outfall (TA-15-72) were plugged and a 4-ft-diameter by 50-ft-deep sump was installed.

We propose to sample the septic tank sludge in two places for radioactivity, uranium, beryllium, lead, silver, VOCs and HEs and then send for laboratory analyses which, in addition, will include SVOCs and exclude HEs unless a positive HE is obtained in the field screening. Again, the organic analyses will be defined by Table 4.7-3. This is summarized in Table 10.2-3 with sampling and analysis tables in Appendix I.

10.2.3.2 SWMUs 15-005(b) and 15-005(c); Container Storage Areas

These two SWMUs [15-005(b) and 15-005(c), Figure EXEC-3] are container storage areas for HEs and are currently regulated under 40 CFR Part 262, Standards Applicable to Generators of Hazardous Wastes. SWMU 15-005(c) is

TABLE 10.2-3

SUMMARY OF SAMPLING PLANS FOR
SWMUs 15-014 (a) AND 15-014 (b)
SWMUs 15-009 (f) AND 15-009 (k)
SWMUs 15-005 (b) AND 15-005 (c)

	FIELD SCREENING							LABORATORY ANALYSES						
	Alpha, Beta, Gamma	Uranium	Silver	Beryllium	Lead	HEs	VOCs	Uranium	Silver	Beryllium	Lead	VOCs	SVOCs	HEs
SWMU 15-014 (a), SWMU 15-014 (b)														
Surface Sampling			6						6				6	
Subsurface Sampling			2				2		2			2	2	
SWMU 15-009 (f) (sludge)	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SWMU 15-009 (k) (sludge)	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SWMU 15-005 (b)	2	2		2	2	2		2		2	2			
SWMU 15-005 (c) (at Firing Site C)	2	2		2	2	2		2		2	2			
TOTALS	8	8	12	8	8	8	6	8	12	8	8	6	12	4

TABLE 10.2-5

ACTIVE SEPTIC SYSTEMS

SWMU	EID	STRUCTURE NUMBER	BUILDING SERVED	YEAR BUILT	CAPACITY GALS.	SUMPS 4' dia. X 50 ' deep	OUTFALL	INFLUENT
15-009 (b)	LA-16	TA-15-61	TA-15-45	1951	540	Yes	Plugged	Sanitary waste
15-009 (c)	LA-17	TA-15-62	TA-15-44	1951	540	No	Plugged	Sink drain
15-009 (d)	LA-18	TA-15-63	TA-15-40	1971	2060	Yes	Plugged	Sanitary waste
15-009 (e)		TA-15-72	TA-15-27	1947	1200	No	Yes	Sanitary waste
15-009 (f)	LA-20	TA-15-195	TA-15-183	1988	4000	Yes	Plugged	Sanitary waste
15-009 (g)	LA-21	TA-15-205	TA-15-185,186	1960	605	No	No, leachfield	Sanitary waste, Sink drains, Water fountains, and floor drains
15-009 (h)	LA-22	TA-15-282	TA-15-280	late 1970's	905	No	No, leachfield	Sanitary waste
15-009 (i)	LA-23	TA-15-284	TA-15-233	1979	750	Yes	Plugged	Sanitary waste, Shower, lavoratory, water fountain, hot water, heater and floor drain
15-009 (j)	LA-37	TA-15-286	TA-15-285	1981	1500	Yes	Plugged	Sanitary waste, shower,sink, water fountain
15-009 (k)		TA-15-423+	TA-15-313		1000	No	No, leachfield	Sanitary waste

+ SWMU Report information is incorrect

located at Firing Point C. It is considered here because of the similarity to SWMU 15-005(b).The sampling plan is shown in Table 10.2-3 with sampling and analysis tables in Appendix I.

We propose to sample the soil outside the buildings in two places (there will be bias for visible staining) for radioactivity, metals (U, Pb, Be), and HEs and then sent for laboratory analyses.

10.3 Potential Release Sites at R-40

10.3.1 SWMU 15-014(h); Outfalls

10.3.1.1 Site Description, History, and Potential Source Terms

SWMU 15-014(h) consists of three outfalls on the northeast side of building TA-15-40 (see Figure 10.3-1) from which noncontact cooling water is emptied.

The first outfall is presently permitted (EPA 04A 013). Before the outfall was permitted by the EPA, its effluent included wastes from a photographic laboratory; therefore, this outfall may contain silver and organic compounds and we propose to check for these contaminants.

The second SWMU,15-014(h), is an outfall from building TA-15-40 located approximately 60 to 100 ft north of the building and in line with the east end of the building. The outfall is an 8-in. vitrified-clay pipe and is permitted as EPA 04A 102. This outfall is supplied by noncontact cooling water, roof drains, and floor drains. The floor drains can receive flow from drain valves in a potable water system. We propose to test this SWMU as we did the first outfall.

The third SWMU 15-014(h) is simply a storm drain that connects a yard drain north and east of building TA-15-40 to an outfall in a grassed area north and east of building TA-15-40. This drainline is a 12-in. corrugated-metal pipe and the outfall empties into Three-Mile Canyon. No further action is recommended for this SWMU because there is no evidence that hazardous materials have ever been put into the yard drain.

10.3.1.2 Potential Pathway and Receptors

Because of the isolation of this area and the projected future land use (Section 4.2), the pathways to receptors may be of concern only if actual digging were done in an area containing high silver or organic compounds.

10.3.1.3 Data Needs

The concentrations of silver compounds and photographic organic compounds need to be determined at the discharge point along the water flow path.

10.3.1.4 Sampling Plan

We propose to collect four 6-in. subsurface samples, one at each outfall and one at the first major sediment depositional area beyond each outfall and screen for silver and VOCs. One sample from each outfall will be sent for laboratory analyses and analyzed for silver, VOCs, and SVOCs as defined in Table 4.7-3. A summary of the sample plan is shown in Table 10.3-1 and sampling and analysis tables shown in Appendix I.

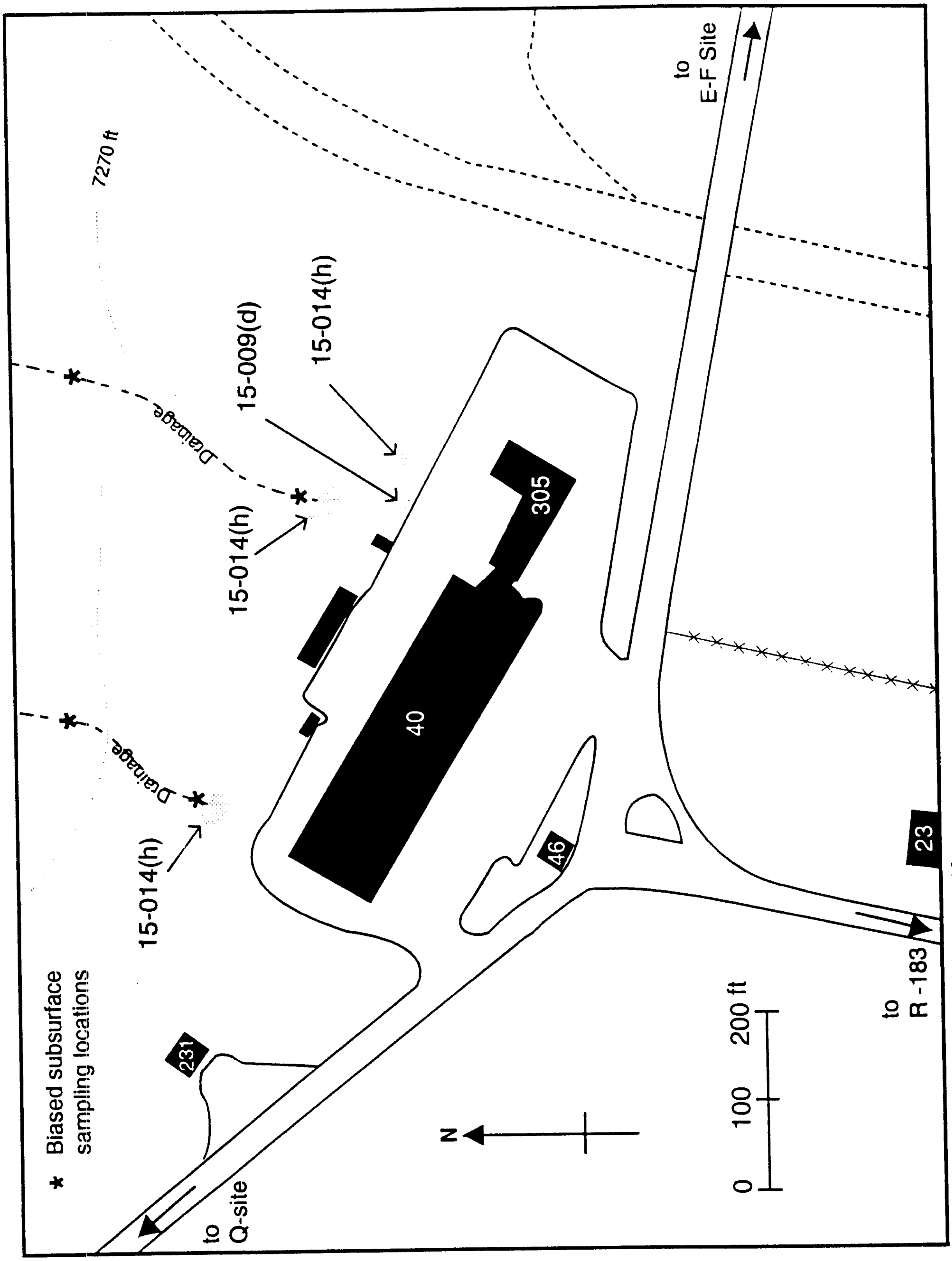


Figure 10.3-1 SWMUs at R-40.

TABLE 10.3-1

SUMMARY OF SAMPLING PLANS

R 40 [SWMUs 15-014 (h), 15-010 (b)]

	FIELD SCREENING					LABORATORY ANALYSES				
	Alpha, Beta, Gamma	Uranium	Silver	HEs	VOCs	Uranium	Silver	VOCs	SVOCs	HEs
SWMU 15-014 (h) (Subsurface 24")			4		4		2	2	2	
SWMU 15-010 (b) Sludge				2						2
(R8) Sediment				2						2
TOTALS			4	4	4		2	2	2	4

10.3.2 SWMU 15-010(b); Septic Tank at Building TA-15-8

Building TA-15-8 was one of the first operational buildings at TA-15. It was constructed in 1947 (ENG-A5 C-48 1947, 10-0024) and used in the 1950s as an HEs machining building (Topography Map, Appendix A). A 5 ft x 5 ft x 5 ft concrete cube, variously described as a septic tank, clean-out tank, or settling tank (TA-15-147) and [SWMU 15-010(b)] was used in the drainline from building TA-15-8 to an outfall at the edge of Three-Mile Canyon. Because HEs were machined in this building with water cooling, it is reasonable to assume that HEs would be found in tank TA-15-147 and at the discharge point.

In addition to taking two samples of septic tank sludge, we propose two samples, one where the drain-line empties at the outfall and one 20 ft from the first point in line of the potential effluent (or at the first point of major sediment deposition). These samples will be tested for HEs. This is shown in Table 10.3-1 and sampling and analysis tables in Appendix I.

CHAPTER 10 REFERENCES

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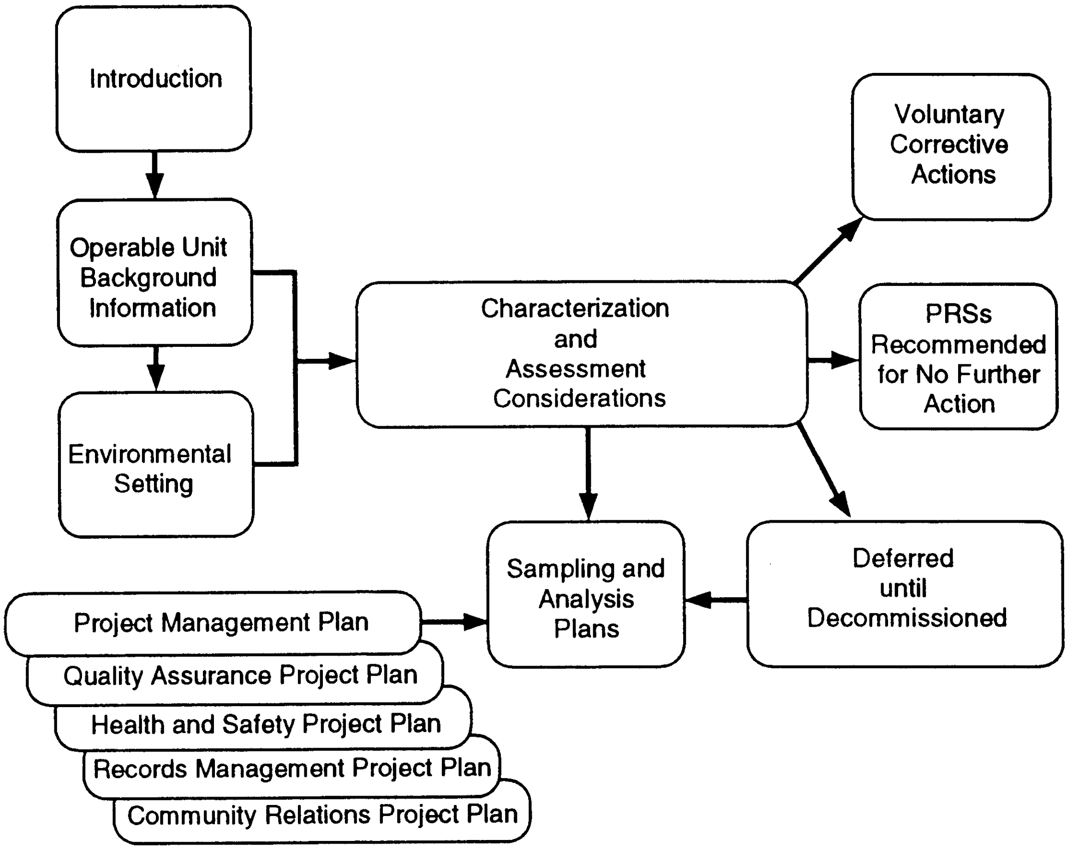
CHAPTER 11



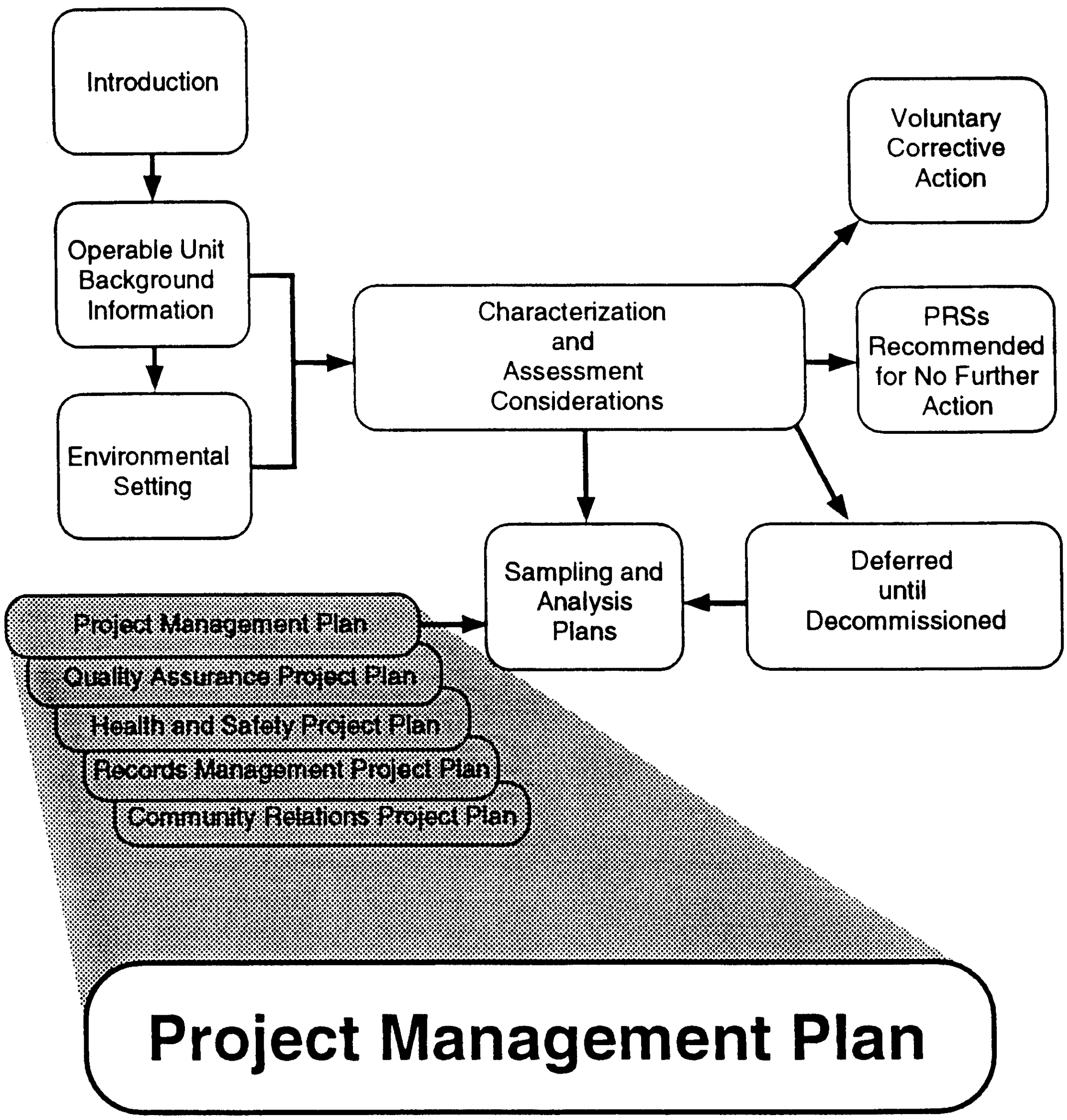
Transferred to Other Operable Units

11.0 TRANSFERRED TO OTHER OPERABLE UNITS

SWMUs 15-006(e) and 15-008(f) are located on I-J site. At one time I-J site was part of TA-15. It is now part of TA-36.

These two SWMUs will therefore be considered in OU 1130, which covers TA - 36.

ANNEX I


Introduction
Operable Unit Background Information
Environmental Setting
Characterization and Assessment Considerations
Voluntary Corrective Action
PRSs Recommended for No Further Action
Deferred until Decommissioned
Sampling and Analysis Plans
Project Management Plan
Quality Assurance Project Plan
Health and Safety Project Plan
Records Management Project Plan
Community Relations Project Plan
Project Management Plan

PROJECT MANAGEMENT PLAN

This annex addresses the project management plan requirements of the HSWA Module (Task II, E., p. 39) of the Laboratory's RCRA Part B Permit (EPA 1990, 0306) and presents the technical approach, management structure, schedule, budget, and reporting milestones for implementation of the OU 1086 RFI as set forth in this work plan. The project management plan for the OU 1086 RFI is an extension of the ER Program project management plan given in Annex I of the Installation Work Plan (IWP) (LANL 1991, 0553).

Figure EXEC-3 of the Executive Summary and Appendix A contain site diagrams and PRS lists for the OU 1086.

I.1 Technical Approach

The approach used for the OU 1086 is based on the ER Program's overall technical approach to the RFI/CMS process as described in Chapter 3 of the IWP (LANL 1991, 0553). The following key features characterize the ER Program approach:

- use of guidelines for cleanup derived from statutory screening action levels and health-based risk assessment utilizing realistic future land uses and potential receptors based on that land use;
- phased sampling approach to site characterization;
- the application of the "observational" or "streamlined" approach to the RCRA Facility Investigation (RFI)/CMS process as a general philosophical framework.

The technical approach employed for the OU 1086 RFI is described in Chapter 4 of this OU work plan. Figure I.1-1 contains a logic diagram for OU 1086 RFI. The general philosophy is to develop and iteratively refine the OU 1086 conceptual model through carefully planned stages of investigation and data interpretation. The data gathered and subsequent interpretation will be used to define the nature and extent of contamination, and the likelihood for waste migration, at the OU 1086. An objective is to support decisions on interim corrective measures or a corrective measures study using the minimum data necessary.

The technical objectives of the OU 1086 RFI, as presented in Chapters 5-10 of this OU work plan, are as follows:

- identify contaminants present at each PRS;
- determine the vertical and lateral extent of the contamination at each PRS;
- identify contaminant migration pathways;

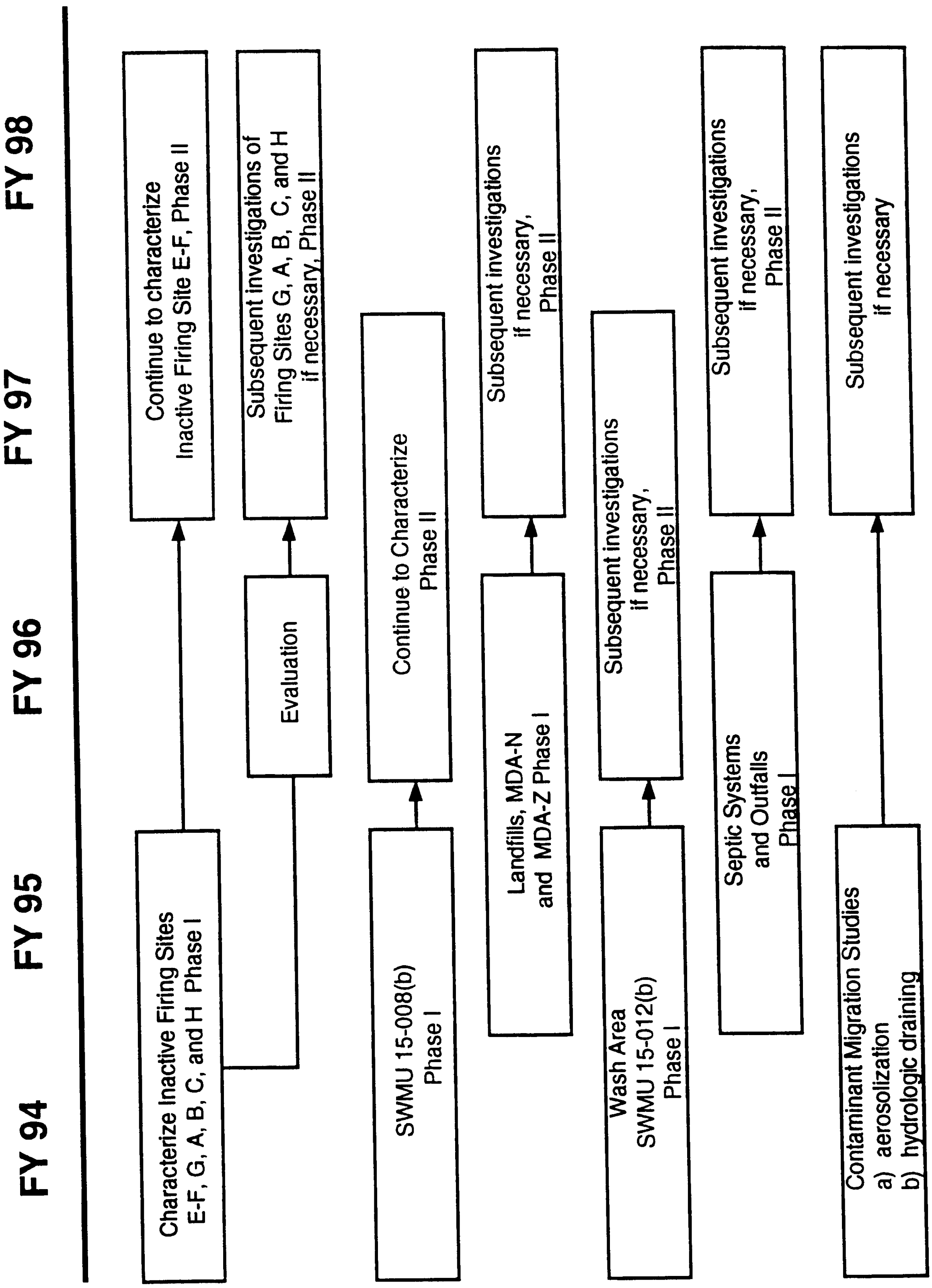


Figure I.1-1 Logic flow of the OU 1086 RFI(also Figure EXEC-6).

- acquire sufficient information to allow quantitative migration pathway modeling and comparison to site specific risk assessment;
- provide data necessary for the assessment of potential remedial alternatives; and
- provide the basis for detailed planning of corrective measures studies (CMS).

I.1.1 Technical Implementation Rationale

As summarized in this section, several relatively independent investigation paths comprise the schedule logic and the investigation rationale for OU 1086, listed as follows:

- Inactive firing sites E-F, A, B, C, G, H
- Landfills MDA-N, MDA-Z and SWMU 15-008(b)
- Wash area, SWMU 15-0012(b)
- Characterization of miscellaneous PRSs such as septic tanks and outfalls.

Inactive Firing Sites E-F, A, B, C, G, H

Investigation of PRSs associated with inactive firing sites are described in Chapter 7 and 8 of this work plan. The characterization studies are designed primarily to determine whether contaminants exist above screening action levels. Phase I investigations will require about two years of field work to complete, followed by Phase II investigations where appropriate.

Landfills MDA-N, MDA-Z, and Wash Area SWMU 15-008(b)

These landfills and SWMU are described in detail in Chapter 9.

Little is known about landfill MDA-N including its exact location. However, it is anticipated that building debris is the main constituent and that it may be slightly contaminated. Phase I sampling will be carried out to measure the nature and extent of the contamination. Geophysical measurements such as seismic sounding, magnetic surveys, and resistivity surveys will be used to delineate the boundaries of the landfill to the greatest extent. MDA-Z mainly contains debris from PHERMEX. After Phase I investigations, a voluntary corrective action may be appropriate.

SWMU 15-008(b) contains debris from active firing site R-44. It is on the edge of the mesa, like MDA-Z and, from the expected contaminants, may be a candidate for voluntary corrective action (VCA).

Wash Area, SWMU 15-0012(b)

A description of this area is provided in Chapter 10, Section 10.2.1. Steel cylinders for contained explosions were washed with water at this location. Phase I investigations are expected to show the necessity for Phase II studies prior to a decision which may or may not suggest CMS.

Miscellaneous PRSs largely consisting of septic systems and outfalls.

There is no urgency to sample and characterize these PRSs because of the location of these sites, the present and future land use of the area, and the estimated low quantities of hazardous materials in them. Characterization of many of these PRSs could be delayed until the Laboratory and/or DOE reach a decision whether a VCA should be carried out at these PRSs, or whether they will be coordinated with D&D activities.

I.1.2 Priorities

The management priorities (in order) of TA-15 RFI are as follows:

1. Inactive firing site E-F contains by far the largest inventory of contaminants at TA-15 and therefore is the most likely to require Phase II investigation and possibly a CMS. Therefore the primary focus of TA-15 is on inactive firing site E-F.
2. Of the landfills, SWMU 15-008(b) probably contains the highest level of contaminants and is situated in a position to possibly contribute to off site contamination.
3. The wash area, SWMU 15-012(b) is known to be radiologically contaminated and may require Phase II and CMS.
4. Inactive firing sites (other than E-F) are expected to contain less contamination than E-F because they were used less frequently for smaller shots in earlier time frames. It is not known, at this time, whether they will require Phase II studies.
5. The landfills MDA-N and MDA-Z cannot be considered similar since MDA-N is already capped with soil and vegetation and MDA-Z is not. After characterization, MDA-N may be recommended for NFA. Landfill MDA-Z may be a candidate for VCA by simply removing the contaminated debris.
6. Phase I investigations of the septic systems and outfalls are not expected to reveal significant contamination. We expect to be able to recommend these for NFA.

I.2 Schedule

General schedule requirements for the Laboratory's ER program are described in Annex I (Program Management Plan) of the IWP. Appendix S of the IWP contains a projected RFI/CMS schedule for the RFI/CMS process for OU 1086, through the completion of the final CMS report. A revised version of this schedule was completed recently as Activity Data Sheet (ADS) 1086 for incorporation in the DOE Environmental Restoration and Waste Management Five-Year Plan. This plan is a key budget planning document for the DOE-wide ER program. The projected RFI/CMS schedule, milestone schedule, and baseline (unconstrained) budget summary submitted recently to DOE for OU 1086 are provided in Table EXEC-5 and in Figures EXEC-4 and I.1-1 of this OU work plan. Figure I.1-2 of this annex contains a detailed projected schedule for the OU 1086 RFI/CMS, based on the unconstrained Five-Year Plan budget/schedule.

Implementation of RFI activities is contingent upon regulatory review and approval of the OU 1086 Work Plan and upon the availability of funding. If the detailed costing of this OU work plan exceeds the planned budget, budgetary resolution will have to be accomplished either by a petition to DOE for additional funding through a change-control procedure or by extension of the RFI schedule. Schedules and costs will be updated through the DOE change control process as appropriate, with revisions submitted to EPA for approval. The assumptions used to generate this schedule include the following.

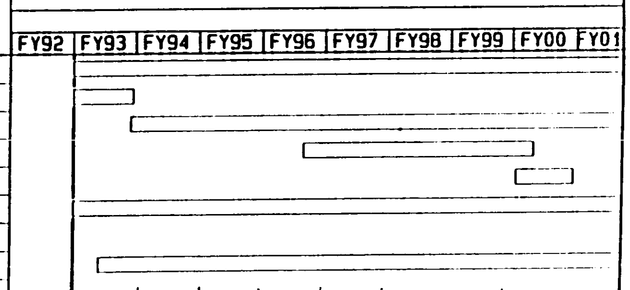
- Review and approval of the OU 1086 RFI work plan and supporting project plans by regulatory agencies.
- Certain tasks may be initiated before regulatory agencies grant final approval of the work plan.
- The schedule assumes that an adequate number of support personnel (e.g., health and safety technicians and trained drilling contractors) will be available.
- EPA approval of technical memoranda/work plan modifications (including EPA comments, Laboratory revision, and final EPA approval) is assumed to take two months, of which one month is allowed for EPA review and comment, and one month for revisions.
- The Phase I work scheduled in the first investigation year (1994) is constrained by the current planned DOE budget.
- Where possible, extensive field work will not be scheduled between October 15 and April 15 each year, to avoid for inclement weather.

I.3 Reporting

Results of RFI field work will be presented in three principal documents: quarterly technical progress reports, technical memoranda/work plan modifications, and the RFI Report. The purpose of these reports is detailed in the following discussion. A schedule of future documents, associated with

FIGURE I.1-2

WBS5	DOE 8 / LANL 5	ORIG DUR	EARLY START	EARLY FINISH
1	ASSESSMENT- ADS MANAGEMENT	2737	1OCT92	30SEP03
2	ASSESSMENT- RFI WORK PLAN	237	1OCT92	14SEP93
3	ASSESSMENT- RFI FIELD WORK	2510	31AUG93	30SEP03
4	ASSESSMENT- RFI REPORT	909	31MAY96	27JAN00
5	ASSESSMENT- CMS PLAN	224	21OCT99	13SEP00
6	ASSESSMENT- CMS WORK & BENCH / PILOT STUDIES	2228	1OCT92	13SEP01
7	ASSESSMENT- CMS REPORT	206	14SEP01	15JUL02
8	ASSESSMENT- VOLUNTARY CORRECTIVE ACTION (VCA)	2141	1MAR93	28SEP01



FIVE YEAR PLAN BASELINE BUDGET

843 2638 3902 2548 2616 2378 2358

Scheduling and budgeting summary of the RFI/CMS for the TA-15 OU (ADS 1086)

Data are based on the budget/schedule information submitted on 24 November 1992 for the DOE ER/WM Five Year Plan baseline.

Plot Date 2JUN93
Data Date 1OCT92
Project Start 1OCT91
Project Finish 30SEP03

(c) Primavera Systems, Inc.

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

Sheet 1 of 1

LANL INC-9 C. MASON
ADS 1086: TA-15 TBS 2/17/92
SUMMARY BAR CHART

ENVIRONMENTAL RESTORATION

Date	Revision	Checked	Approved

implementation of this OU work plan, which are deliverable to EPA and DOE, is summarized in the following list.

Document	EPA	DOE	Date Due
Monthly	X	X	25th of the following month
Quarterly	X		Feb. 15, May 15, & Aug. 15
Phase Reports	X	X	as in baseline; DOE milestones

I.3.1 Monthly Progress Reports

These are prepared in the Program Office. Highlights from OU 1086 will be submitted to the Program Office.

I.3.2 Quarterly Technical Progress Reports

As the OU 1086 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, page 46). Detailed technical assessments will be provided in technical memoranda/work plan modifications.

I.3.3 Technical Memoranda/Work Plan Modifications

Technical memoranda/work plan modifications will be submitted for work conducted on OU 1086 SWMUs. These documents will function as interim reports on portions of the RFI effort because of the multi-year time frame which will be required for completion of RFI field work. In other words, these technical memoranda 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.3.4 RFI Report

The RFI report for the OU 1086 will summarize all field work conducted during the RFI. As required by the HSWA module of the Laboratory's RCRA Part B operating permit, the Laboratory will submit an RFI report within 60 days of completion of the RFI. As stated in Chapter 3 of the IWP (LANL 1991, 0553), 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 also will contain adequate information to support delisting of sites that require no further corrective action.

I.4 Budget

The schedule presented in Figure I.1-1 is based on a constrained budget for the first year of the RFI and preliminary cost analysis which is subject to significant uncertainties. The projected budget in fiscal year 1994 (FY 94) is based on expected DOE funding levels and is subject to change depending upon funding allocations actually made. A change control petition to DOE is required to augment these funding levels. Because DOE funding requests are set two years in advance, the first year in which the OU 1086 RFI is not constrained by previous budget estimates will be FY 95. Funding requests for FY 95 and beyond will reflect the cost and schedule that most efficiently complete the RFI plans.

As pointed out above, the RFI costing is being refined and is subject to considerable uncertainties at the present time.

I.5 OU 1086 Organization and Responsibility

The organizational structure for the ER Program is presented in Chapter 2 of the generic LANL ER Program Quality Program Plan and Quality Assurance Project Plan (QPP/QAPjP). ER Program lines of authority and responsibilities are identified in that document and in Figures I.5-1 and I.5-2 of this annex.

Records of qualifications and training of all field personnel working on the RFI for the OU 1086 will be kept as ER Records [see Annex IV of the IWP, Records Management Plan]. Technical Contributors to the OU 1086 work plan are listed in Appendix I of this OU work plan.

The responsibilities of the positions identified in Figures I.5-1 and I.5-2 are summarized in the following subsections.

I.5.1 OU Project Leader

Responsibilities of the OU 1086 Project Leader are as follows:

- oversees day-to-day RFI operations, including planning, scheduling, and reporting of technical and administrative activities;
- ensures preparation of scientific investigation planning documents and procedures;
- prepares monthly and quarterly reports for the Project Manager (PM);
- oversees subcontractors, as appropriate;
- coordinates with technical team leaders
- conducts technical reviews of the milestones and final reports;

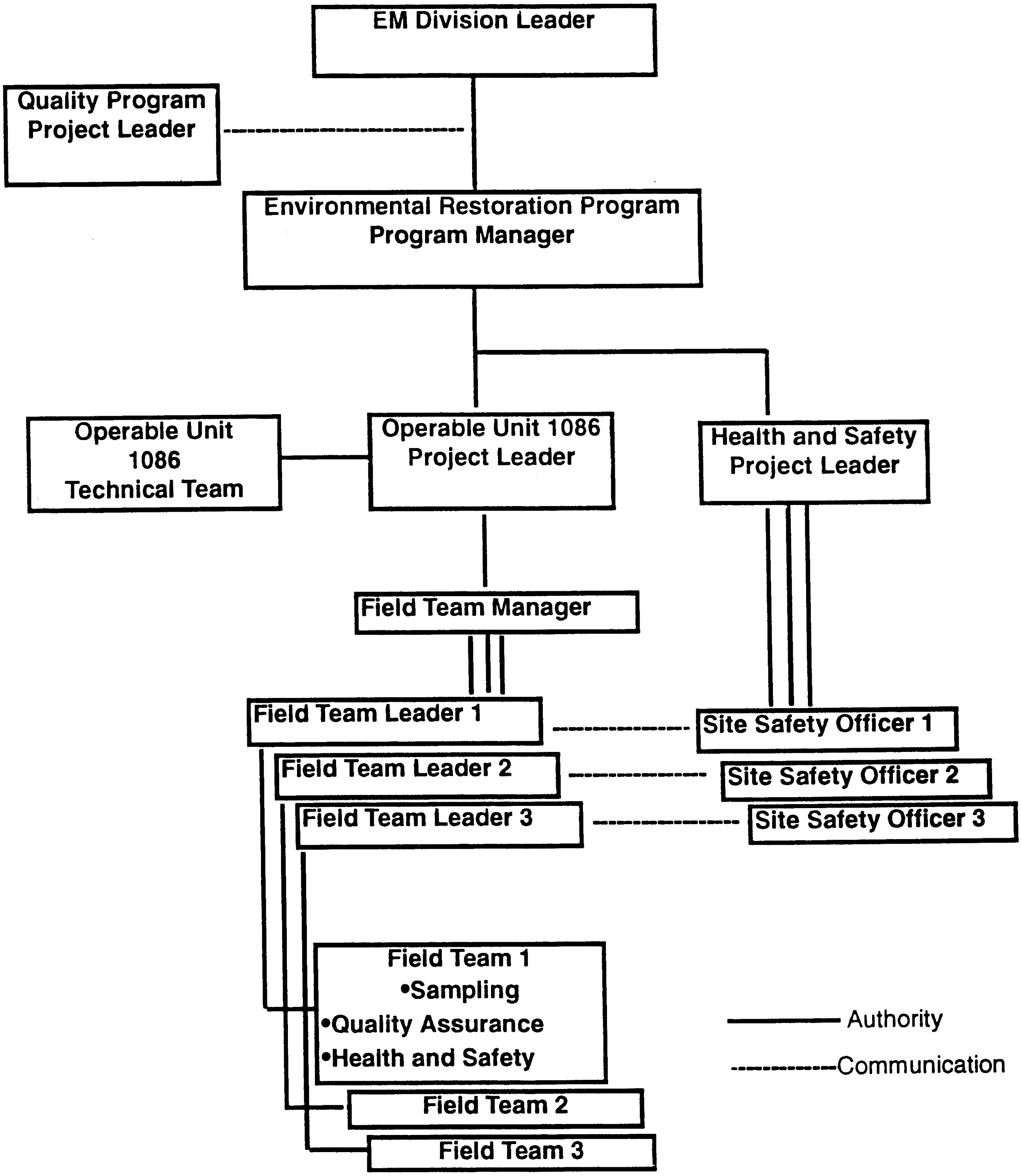


Figure I.5-1 Operable Unit 1086 field work organization chart showing lines of authority and responsibility

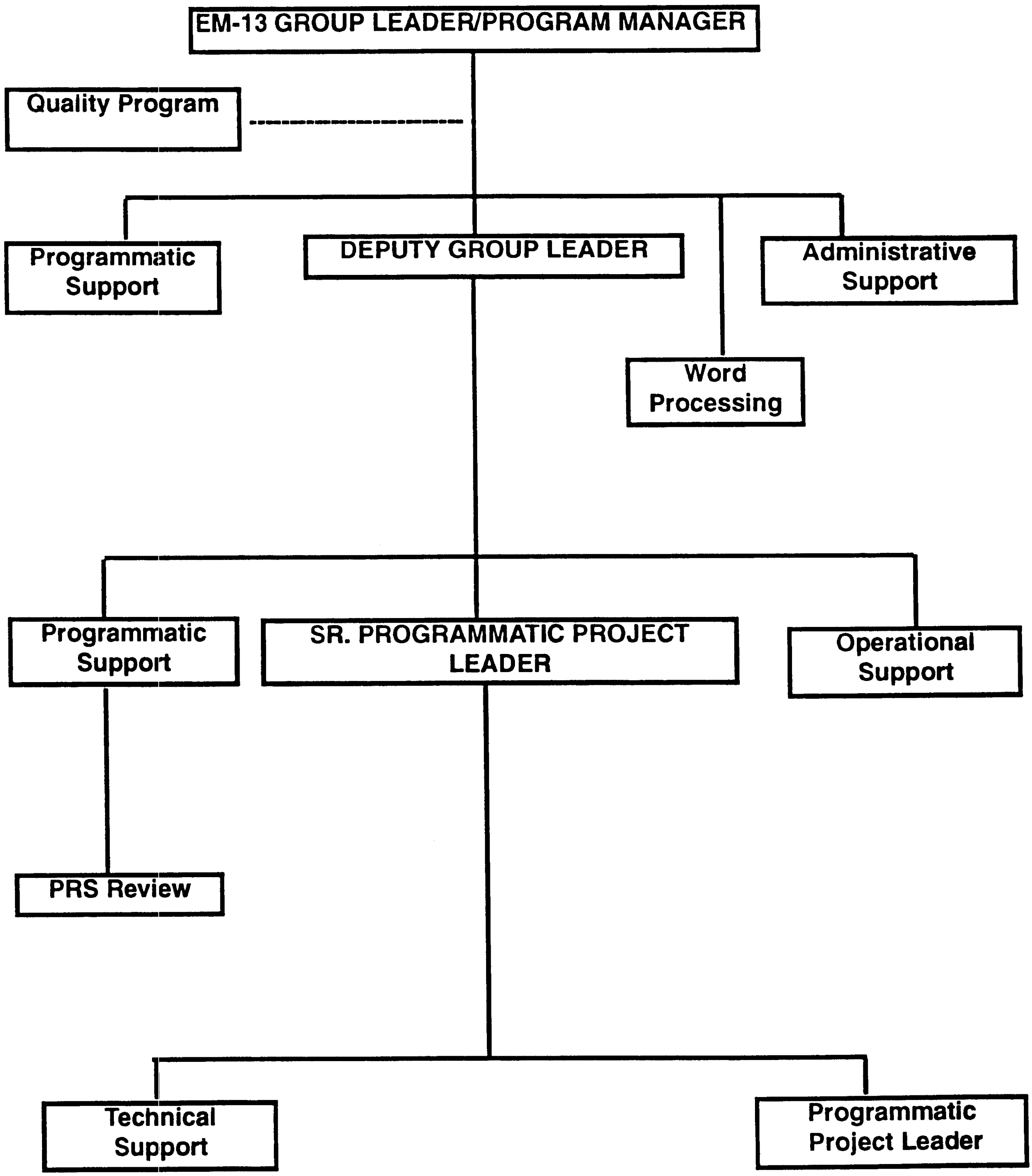


Figure I.5-2 Laboratory ER Program organizations

- interfaces with the ER Quality Program Project Leader (QPPL) to resolve quality concerns and to coordinate with the QA staff for audits;
- complies with the LANL ER Program Health and Safety (HS), records management, and community relations requirements;
- oversees RFI field work and manages the field teams manager; and
- complies with the Laboratory's technical and QA requirements for the LANL ER Program.

I.5-2 Technical Team Members

Technical team members are responsible for providing technical input for their discipline throughout the RFI/CMS process. Technical team members have participated in the development of the OU 1086 work plan and the individual field sampling plans and will continue to participate in the field work, data analysis, report preparation, work plan modifications, and planning of subsequent investigations as necessary.

The primary disciplines currently represented on the OU 1086 technical team are chemistry, geology, hydrology, geochemistry, statistics, biology, archaeology, and health physics. The composition of the technical team may change with time as the technical expertise needed to implement the OU 1086 RFI changes.

I.5-3 Field Teams Manager

Responsibilities of the OU 1086 Field Teams Manager include the following:

- conducts detailed planning and scheduling for the implementation of the RFI field activities outlined in Chapters 7 through 10;
- oversees day-to-day field operations; and
- manages field team activities.

1.5-4 Field Team Leader(s)

The Field Teams Manager will assign field work 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 as appropriate for the activity. Field Team Leaders may be Laboratory or contractor personnel.

1.5-5 Field Team Member(s)

Field Team Members may include the following, as appropriate:

- field team leader
- sampling personnel,
- site safety officer,
- geologists,
- hydrologists,
- health physicists, and
- other applicable disciplines.

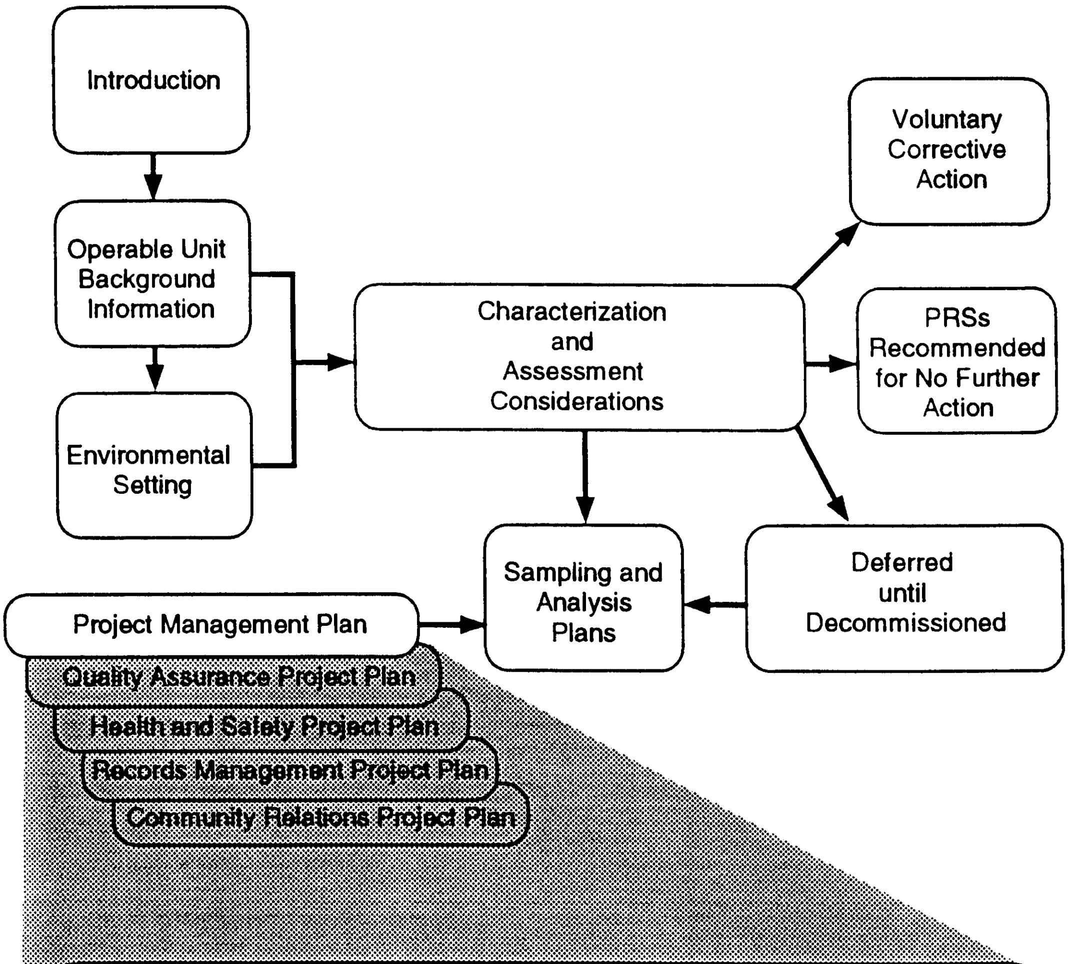
All teams will have, at a minimum, a site safety officer and a qualified field sampler. Field team members may be Laboratory or contractor personnel. The field team leader is responsible for conducting the work detailed in the field sampling plans.

Annex I References

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

LANL (Los Alamos National Laboratory), November 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)

ANNEX II



Quality Assurance Project Plan

SIGNATURE PAGE

Approval for Implementation

1. **NAME:** Robert Vocke
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3. **NAME:** Craig Leasure
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4. **NAME:** Margaret Gautier
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5. **NAME:** Barbara Driscoll
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   SIGNATURE:____________________________ **DATE:** __________

7. **NAME:** Caroline Mason INC-9
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INTRODUCTION

This Quality Assurance Project Plan (QAPjP) for the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Work Plan for Operable Unit (OU) 1086 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 [Quality Program Plan and Quality Assurance Project Plan for Environmental Restoration, January 1993].

The Laboratory ER Program Generic QAPjP describes the format for the individual OU QAPjPs. In the Generic QAPjP, Section 1.0 is the Signature Page, which is included in the front of this annex. Section 2.0 of the Generic 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 (to Annex II) 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 1086 QAPjP matrix (Table II-1) appears as a table in which the Generic QAPjP criteria are listed 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 1086 QAPjP must meet; the subsection titles and numbers in the second column correspond directly with those contained in Generic QAPjP. Sections of the Generic QAPjP that do not contain specific requirements are not included in the matrix, e.g., 3.4. The third column lists the location of information in the IWP and/or the OU 1086 Work Plan that fulfills the requirements in the Generic QAPjP. If OU 1086 will be following 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 functions. The OU 1086 Work Plan, Annex I, describes the organizational structure from the PL-level down and presents an organizational chart to demonstrate line authority.

Note 2: Sections 5 and 9
In conjunction with the generic QAPjP, the level of analysis for each individual SWMU will reflect the objective (precision, accuracy, and sensitivity) necessary for the particular conditions. The detection limits must be compatible with environmental media concentrations corresponding to decision levels, and sensitivity may be modified to meet these objectives.

Note 3: Section 14.3 Sample Representativeness
The field sampling plans presented in the OU 1086 Work Plan, Chapters 7 through 10, 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].]

Note 4: Section 16.1 Field Quality Assurance Reports to Management
The OU 1086 Field Teams Leader, or a designee, will provide a monthly field progress report to the Laboratory 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].

TABLE II-1

OU 1086 QAPjP MATRIX

Generic QAPjP Criteria	Generic QAPjP Requirements by Subsection	OU 1086 Incorporation of Generic QAPjP Requirements
Project Description	3.2 Facility Description	Los Alamos National Laboratory (LANL) ER Program IWP, Section 3.0, and OU 1086 Work Plan, Chapters 1, 2, and 3.
	3.3 ER Program	LANL ER Program IWP. Section 2.0.
	3.4.1 Project Objectives	OU 1086 Work Plan, Chapters 1and 4.
	3.4.2 Project Schedule	OU 1086 Work Plan, Annex I.
	3.4.3 Project Scope	OU 1086 Work Plan, Chapters 1 and 4.
	3.4.4 Background Information	OU 1086 Work Plan, Chapters 1, 2 and 3.
	3.4.5 Data Management	OU 1086 Work Plan, Annex IV, and LANL ER Program IWP, Annex IV.
Project Organization	4.1 Line Authority	OU 1086 Work Plan, Annex I.
	4.2 Personnel Qualifications, Training , Resumes	Maintained as Records within OU 1086 record system and summarized in Appendix I.
	4.3 Organizational Structure	LANL-ER-QPP, Section 2.0, and OU 1086 Work Plan, Annex I. See also **Note 1**.
Quality Assurance Objectives for Measurement Data in Terms of Precision, Accuracy, Representativeness, Completeness, and Comparability See **Note 2.**	5.1 Level of Quality Control	Generic QAPjP accepted.
	5.2 Precision, Accuracy, and Sensitivity of Analyses	Generic QAPjP accepted. See also **Note 2**.
	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 1086 Work Plan, Chapter 4

TABLE II-1 (continued)

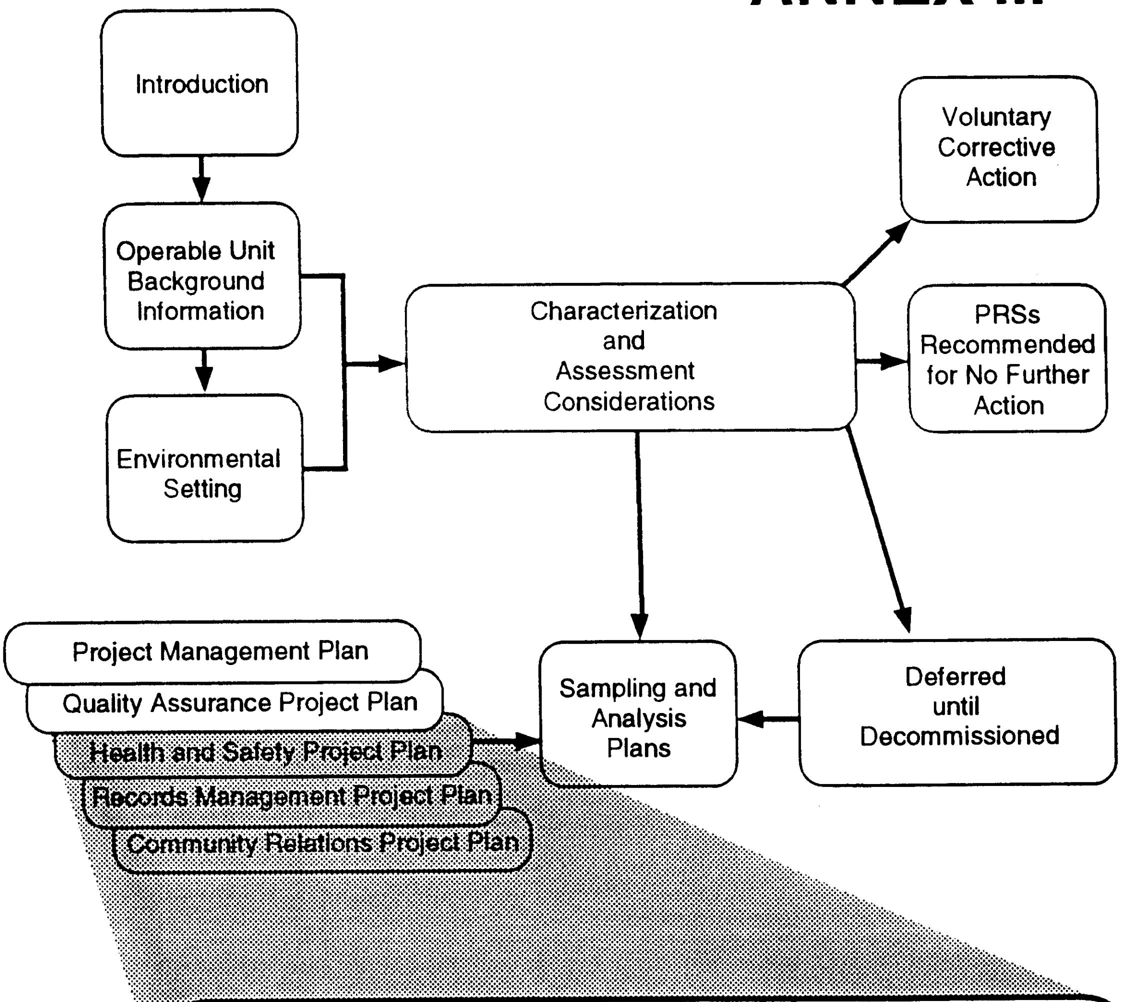
OU 1086 QAPjP MATRIX

Generic QAPjP Criteria	**Generic QAPjP Requirements by Subsection**	**OU 1086 Incorporation of Generic QAPjP Requirements**
Sampling Procedures	6.0 Sampling Procedures	OU 1086 Work Plan, Appendix C
	6.1 Quality Control Samples	Generic QAPjP accepted. Including ER Program SOP-01.05.
	6.2 Sample Preservation During Shipment	Generic QAPjP accepted. Including ER Program SOP-01.02.
	6.3 Equipment Decontamination	Generic QAPjP accepted. Including ER Program SOP-01.06.
	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.
Analytical Procedures See **Note 2.**	9.1 Overview	Generic QAPjP accepted. See also **Note 2.**
	9.2 Field Testing and Screening	Generic QAPjP accepted. Including ER Program SOP-06.02
	9.3 Laboratory Methods	Generic QAPjP accepted. Sampling plans are described in OU 1086 Work Plan, Chapter 7–10.
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.

REFERENCES

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)

ANNEX III



Health and Safety Project Plan

1.0 INTRODUCTION

1.1 Purpose

The purpose of this Operable Unit Health and Safety Plan (OUHSP) is to recognize potential safety and health hazards, describe techniques for their evaluation, and identify control methods. The goal is to eliminate injuries and illness; to minimize exposure to physical, chemical, biological, and radiological agents during environmental restoration (ER) activities; and to provide contingencies for events that may occur while these efforts are under way.

It is intended that project managers, health and safety professionals, laboratory managers, and regulators use this OUHSP as a reference for information about health and safety programs and procedures as they relate to this operable unit (OU). OU specific information can be found in sections 3 and 4 of this document. The other sections of this document contain general information applicable to all OUs. Detailed Site-Specific Health and Safety Plans (SSHSPs) and procedures will be prepared subsequent to this document for each field activity planned, be it specific to a single Potential Release Site (PRS) or a group of PRSs being investigated simultaneously.

The Health and Safety Division Hazardous Waste Operations (HAZWOP) Program establishes laboratory policies for health and safety activities at ER sites. The hierarchy of health and safety documents for the Los Alamos National Laboratory (the Laboratory) ER Program is as follows:

1. Installation Work Plan, Health and Safety Program Plan (IWPHSPP)
2. OUHSP
3. SSHSP

The first document is more general, while the others become increasingly more specific and detailed. While each document is written so it can stand alone, the contents and references to these and other documents should always be considered when making decisions.

1.2 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.

1.3 Required Elements of the SSHSP

OSHA (29 CFR 1910.120(b)(4)(ii) requires that the site health and safety plan, as a minimum, address the following elements.

1. A safety and health risk or hazard analysis for each site task and operation found in the work plan.
2. Employee training appropriate for the tasks to be performed.
3. Personal protective equipment to be used by employees for each task and operation being conducted.
4. Medical surveillance requirements for site workers.
5. Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment to be used.
6. Site control measures to be used.
7. Decontamination procedures to be used.
8. The emergency response plan for safe and effective responses to emergencies.
9. Confined space entry procedures, when applicable.
10. A spill contaminant program.

Each SSHSP prepared for work at sites within OU 1086 will address the above elements, as a minimum.

2.0 Organization, Responsibility, and Authority

2.1 General Responsibilities

The Laboratory's Environment, Safety, and Health (ES&H) manual delineates managers' and employees' responsibility for conducting safe operations and providing for the safety of contract personnel and visitors. Line Management is responsible for implementing health and safety requirements.

Personnel conducting work for the ER Program shall comply with the Laboratory's stop-work policy. In addition, upon initiation of stop-work actions, ER Program personnel shall notify the Site Safety Officer (SSO), the ER Program HSPL, and the OUPL.

2.1.1 Kick-Off Meeting

A health and safety kick-off meeting will be held before field work begins. The purpose of the meeting is to reach a consensus on responsibility, authority, lines of communication, and scheduling. The HSPL will organize the meeting and has the authority to delay field work until the kick-off meeting is held.

2.1.2 Readiness Review

A field readiness review must be completed by the OUPL before field activities begin. The HSPL is responsible for approving the health and safety section of the readiness review.

2.2 Individual Responsibilities

Laboratory employees and supplemental work force personnel are responsible for health and safety during ER Program activities. Figure III-1 illustrates the field work organizational chart, showing the line organization. The personnel with direct authority for implementation of SSHSPS are the HSPL, the OUPL and the SSO. The responsibilities of each person are as described in the he following subsections.

2.2.1 Health and Safety Project Leader

The HSPL helps the OUPL in identifying resources to be used for the preparation and implementation of the OUHSP. 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.

2.2.2 Operable Unit Project Leader

The OUPL is responsible for all investigation activities for his/her assigned OU. Specific health and safety responsibilities include:

- preparing, reviewing, implementing, and revising OUHSPs;
- interfacing with the HSPL to resolve health and safety concerns; and
- notifying the HSPL of schedule and project changes.

2.2.3 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;

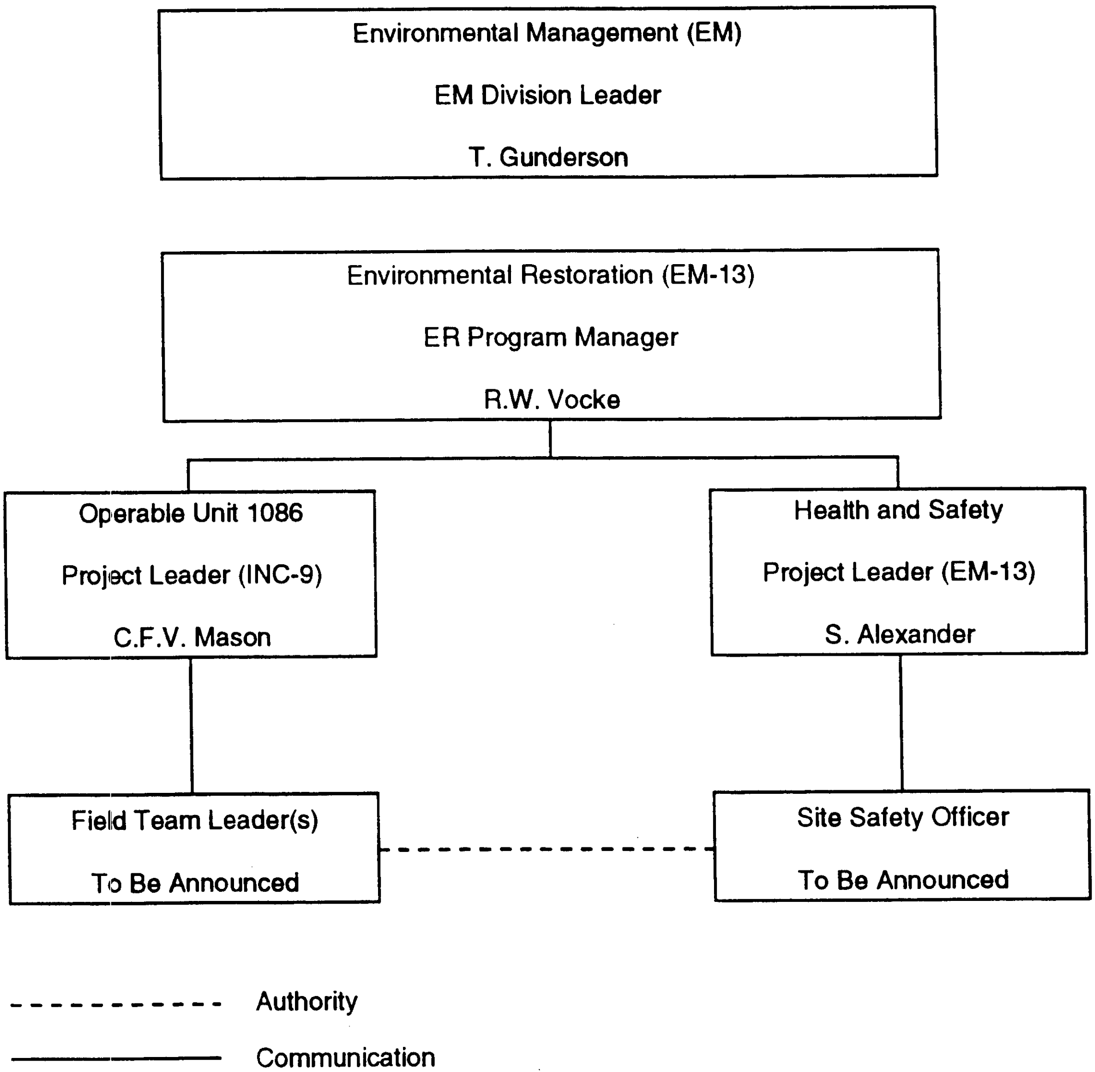


Figure III-1 Operable unit 1086 work organization chart showing health and safety responsibilities

- determining protective clothing requirements;
- inspecting protective clothing 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;
- controlling emergency situations in collaboration with Laboratory personnel;
- ensuring that all personnel are trained in the appropriate safety procedures and are familiar with the SSHSP and that all requirements are followed during OU activities;
- conducting daily health and safety briefings for field team members;
- stopping work when unsafe conditions develop or an imminent hazard is perceived;
- inspecting to determine whether SSHSP is being followed; and
- maintaining first aid supplies.

2.3 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. 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 to the site may only be present with the express permission of the Laboratory's operating group, M-4.

2.4 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 the SSHSP governing all sitre activities. The HSPL has the ultimate authority to accept or reject SSHSPS prepared by supplemental work force personnel for specific project assignments.

Contractors will adhere to the requirements of all applicable health and safety plans. Laboratory personnel will monitor activities to ensure that this is done. Failure to adhere to these requirements can cause work to stop until compliance is achieved.

Contractors will provide their own health and safety functions unless other contractual agreements have been arranged. Such functions may include, but are not limited to, providing qualified health and safety officers for site work, imparting a corporate health and safety environment to their employees, providing calibrated industrial hygiene and radiological monitoring equipment, enrolling in an approved medical surveillance program, supplying approved respiratory and personal protective equipment (PPE), providing safe work practices, and training hazardous waste workers.

2.5 Personnel Qualifications

The HSPL will establish minimum training and competency requirements for on-site personnel. These requirements will meet or exceed 29 CFR 1910.120 regulations.

2.6 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.

3.0 Scope of Work

3.1 Comprehensive Work Plan

The initial phase of the RFI OU 1086 work plan is the investigation and characterization, involving environmental sampling and field assessment of the areas. This OUHSP addresses the tasks in the Phase I study. Tasks for additional phases will be addressed in revisions to this document.

3.2 Operable Unit Description

OU 1086 consists of 79 potential release sites (PRSs). These include 66 solid waste management units and 13 areas of concern. Thorough descriptions and histories of these sites can be found in Chapters 5-10. Table III-1 summarizes the PRSs, the potential chemical hazards, and the work planned at this time.

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.

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, high altitude, rock slides,m very irregular terrain, lightning, and other hazards prevalent at Los Alamos, are less apparent. Physical hazards will be addressed thoroughly in the SSHSP.

4.1.1 High Explosives (HEs)

At TA-15, in general, HE contamination has not been found and is not expected. However, spot tests will be extensively used to confirm or deny this expectation. At one site only, SWMU 15-010(b), there may be extensive weathered HEs. Materials should not be handled without proper authorization from the explosives safety expert who will be identified in the SSHSP.

4.2 Chemical Hazards

A variety of chemical contaminants are known or are suspected to be present at this OU, including uranium, beryllium, lead, and a few others.

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-1
Summary of Chemical Hazards Anticipated During Site Work at PRSs, OU 1086

Description	Substance of Concern	Tasks
Firing Sites	Radionuclides[1], metals[2]	Soil sampling, field surveys[3]
Waste Storage	Radionuclides[1], metals[2]	Soil sampling, field surveys[3]
Landfills, Waste Pits and Wash Areas	Radionuclides[1], metals[2]	Soil sampling, sampling of landfill waste pit contents, field surveys[3]
Septic Systems	Radionuclides[1], metals[2], organic substances	Sampling of septic systems, field surveys[3]
Drains and Outfalls	Radionuclides[1], metals[2] organic substances	Soil sampling, field surveys[3]

1. Radionuclides at OU 1086 consist primarily of uranium and depleted uranium.
2. The metals of most concern are uranium, beryllium, lead, and to a lesser extent, mercury. Occasionally metals will include thorium, silver, and chromium.
3. Field surveys consist of radiological, electromagnetic and land surveys. One or more of the field surveys will be performed at each site.

4.3 Radiological Hazards

A very limited number of radionuclides are known or are suspected to be present. The SSHSP will provide information for known or suspected radionuclides that will include the type of radiation emitted, the permissible exposure concentrations, and the monitoring instruments recommended for detection under field conditions.

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, and black widow spiders.

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. The major task that should be analyzed and documented in the the SSHSP are:

- digging and possibly drilling, as some subsurface soil sampling will be required,
- hand augering,
- septic and chemical waste system sampling,
- high explosive sampling, and
- canyon side sampling.

Other tasks should be considered for inclusion by the SSO.

The task analysis will include a general characterization of the health and safety concerns at an individual PRS or group or PRSs and an evaluation of risks posed when performing individual tasks such as drilling, hand augering, etc. When chemical hazards are known, they will be identified in the SSHSP and categorized in regard to the relative degree of hazard posed to site workers. Physical hazards at each PRS or group of PRS included in the SSHSP will be identified and evaluated so that workers may take precaution against the often overlook physical hazards at a site.

5.0 Site Control

5.1 Initial Site Reconnaissance

This will be carried out only after authorization of and compliance with the operating group as this is an active functional site. Initial site reconnaissance may involve surveyors, archaeologists, biological resource personnel, etc. Health and safety concerns that may be present must be addressed to protect personnel. The OUPL and HSPL will identify these concerns and institute measures to protect environmental impact assessment personnel.

5.2 Site-Specific Health and Safety Plans

Each area to be sampled within the OU requires an SSHSP. Planning, special training, supervision, protective measures, and oversight needs are different for each event, and the SSHSP addresses this variability.

The OUHSP provides detailed information to project managers, Laboratory managers, regulators, and health and safety professionals about health and safety programs and procedures as they relate to an OU. The SSHSP addresses the safety and health hazards of each phase of site operations and includes requirements and procedures for employee protection. All SSHSPs in that OU derive from the OUHSP.

The standard outline for an SSHSP follows OSHA requirements and serves as a guide for best management practice. Those performing the field work are responsible for completing the plan.

Changes to the SSHSP must be made in writing. The HSPL shall approve changes, and site personnel shall be updated through daily tailgate meetings. Records of SSHSP approvals and changes will be maintained by the SSO.

5.3 Work Zones

Maps identifying work zones will be included with each SSHSP. Markings used to designate each zone boundary (red or yellow tape, fences, barricades, etc.) will be discussed in the plan. Evacuation routes should be upwind or crosswind of the exclusion zone. A muster area must be designated for each evacuation route. Discrete zones are not required for every field event. The SSO will determine work zones. The following sections discuss the work zones.

- Exclusion zone. The exclusion zone is the area where contamination is either known or likely to be present or, because of work activities, will present a potential hazard to personnel. Entry into the exclusion zone requires the use of PPE.
- Decontamination zone. The decontamination zone is the area where personnel conduct personal and equipment decontamination. This zone provides a buffer between contaminated areas and clean areas. Activities in the decontamination zone require the use of PPE as defined in the decontamination plan.
- Support zone. The support zone is a clean area where the chance to contact hazardous materials or conditions is minimal. PPE other than safety equipment appropriate to the tasks performed (e.g., safety glasses, protective footwear, etc.) is not required.

5.4 Secured Areas

Secured areas shall be identified and shown on the site maps. Procedures and responsibilities for maintaining secured areas must be described. Standard Laboratory security procedures should be followed for accessing secure areas. All contractors and visitors must be processed through the badge office before entering secure areas. It is the responsibility of the OUPL to see that contractor personnel have badges. It is the responsibility of all Laboratory employees to enforce security measures.

5.5 Communications Systems

Portable telephones, CB radios, and two-way radios may be used for on-site communications.

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. General safe work practices will be included in the SSHSP. Topics will include use of the buddy system; eating, drinking, smoking at the site; housekeeping at the site; contingency planning, worker conduct while onsite and other practices that may be appropriate at the site.

5.7 Specific Safe-Work Practices

5.7.1 Electrical Safety-Related Work Practices

The most effective way to avoid accidental contact with electricity is to de-energize the system or maintain a safe distance from the energized parts/line. OSHA regulations require minimum distances from energized parts. An individual working near power lines must maintain at least a 10 foot clearance from overhead lines of 50 kilovolts (kV) or less. The clearance includes any conductive material the individual may be using. For voltages over 50 kV, the 10 foot clearance must be increased 4 inches for every 10 kV over 50 kV.

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 or ground fault circuit interrupters is required.

5.7.3 Lockout/Tagout

All site workers follow a standard operating procedure for control of hazardous energy sources [Laboratory Administrative Requirement (AR) 8-6, LP 106-01.1). Lockout/tagout procedures are used to control hazardous energy sources, such as electricity, potential energy, thermal energy, chemical corrosivity, chemical toxicity, or hydraulic and pneumatic pressure.

5.7.4 Handling Drums and Containers

Drums and containers used during clean up shall meet U.S. Department of Transportation, OSHA, and EPA regulations. Work practices, labeling requirements, spill containment measures, and precautions for opening drums and containers shall be in accordance with 29 CFR 1910.120. Drums and containers that contain radioactive material must also be labeled in accordance with AR 3-5, Shipment of Radioactive Materials; AR 3-7, Radiation Exposure Control; and Article 412, Radioactive Material Laboratory, DOE Radiological Control Manual. Provisions for these activities shall be clearly outlined in the SSHSP, if applicable.

5.7.5 Illumination

Illumination shall meet the requirements of Table H-120.1, 29 CFR 1910.120.

5.7.6 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.

5.7.7 Packaging and Transport

The OUPL should contact EM-7 to determine requirements for storing and transporting hazardous waste to ensure that practices for storage, packaging, and transportation comply with ARs 10-2 and 10-3. Disposal of hazardous wastes generated from a project will be handled by EM-7

5.7.8 Extended Work Schedules

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

5.8 Permits

The following permits may be required for field activities:

- Excavation Permits
- Radiation Work Permits
- Special Work Permit for Spark/Flame-producing Operations
- Lockout/Tagout Permits

The SSO and OUPL are responsible for obtaining permits and maintaining documentation. Permits are specifically addressed in the SSHSP.

6.0 Personal Protective Equipment

6.1 General Requirements

If engineering controls and work practices do not provide adequate protection against hazards, personal protective equipment (PPE) may be required. For each operation included in the SSHSP, appropriate PPE will be designated. Use of PPE is required by OSHA regulations in 29 CFR Part 1910 Subpart I. Subcontractors are responsible for supplying PPE to their workers.

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 3.1, and Appendix 3C of the DOE Radiological Control Manual contain guidelines for the use of PPE during radiological operations.

6.3.3 Protective Equipment

Protective equipment, including protective eyewear and shoes, head gear, hearing protection, splash protection, lifelines, and safety harnesses, must meet American National Standards Institute standards.

6.4 Respiratory Protection Program

When engineering controls cannot maintain airborne contaminants at acceptable levels, appropriate respiratory protective measures shall be instituted. The Health and Safety Division administers the respiratory protection program, which defines respiratory protection requirements; verifies that personnel have met the criteria for training, medical surveillance, and fit testing; and maintains the appropriate records.

All supplemental workers shall submit documentation of participation in an acceptable respiratory protection program to the Industrial Hygiene Group (HS-5) for review and signature approval before using respirators on-site.

7.0 Hazard Controls

7.1 Engineering Controls

OSHA regulations state that when possible engineering controls should be used as the first line of defense for protecting workers from hazards. Engineering controls are mechanical means for reducing hazards to workers, such as guarding moving parts on machinery and tools or using ventilation during confined space entry. Specific engineering controls appropriate for site conditions will be described in the SSHSP.

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. Specific administrative controls will be presented in the SSHSP.

8.0 Site Monitoring

A monitoring program or plan that meets the requirements of 29 CFR 1910.120 will be implemented for TA-15. 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.

8.1 Chemical Air Contaminants

DOE has adopted OSHA PELs and ACGIH TLVs as standards for defining acceptable levels of exposure. The more stringent of the two limits applies.

8.1.1 Measurement

Measurements of chemical contaminants can be performed using direct or indirect sampling methods. Direct methods provide near real-time results and are often used as screening tools to determine levels of PPE, the need for additional sampling, etc. Indirect sampling means that a sample is collected in the field and transported to a laboratory for analysis. It will be up to the SSO to determine the most appropriate sampling method for each situation. If there are any questions about sampling methodology, the SSO should consult with the HSPL or a certified industrial hygienist.

8.1.2 Personal Monitoring

The site history should be used to determine the need for monitoring for specific chemical agents. Initial air monitoring shall be performed to characterize the exposure levels at the site and to determine the appropriate level of personal protection needed. Monitoring strategies will emphasize worst-case conditions if monitoring each individual is inappropriate.

8.1.3 Perimeter Monitoring

Perimeter monitoring shall be performed to characterize airborne concentrations in adjoining areas. If results indicate that contaminants are moving off-site, control measures must be re-evaluated. The perimeter is defined as the boundary of the OU site.

8.2 Radiological Hazards

When radiological hazards are known or suspected, workplace monitoring shall be performed as necessary to ensure that exposures 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-7, Radiation Exposure Control.

8.3 Other Hazards

Other hazards such as the noise hazard, will be monitored as appropriate. Monitoring for other hazards will be included in the SSHSP when those hazards are anticipated.

9.0 Medical Surveillance and Monitoring

9.1 General Requirements

A medical surveillance program shall be instituted to assess and monitor the health and fitness of workers engaged in HAZWOP. Medical surveillance is required for personnel who are or may be exposed to hazardous substances at or above established PELs for 30 days in a 12-month period, as detailed in 29 CFR 1910.120. Medical surveillance is also required for personnel with duties that require the use of respirators or with symptoms indicating possible overexposure to hazardous substances.

Contractors are responsible for medical surveillance of their employees. The Health and Safety Division will audit contractor programs.

9.2 Medical Surveillance Program

All field team members who participate in ER Program investigations shall participate in a medical surveillance program. The program shall conform to DOE Order 5480.10, 29 CFR 1910.120, AR 2-1, and any criteria established by the Occupational Medicine Group (HS-2) at the Laboratory. The program shall provide for initial medical evaluations to determine fitness for duty and subsequent medical surveillance of individuals engaged in hazardous waste operations.

9.4 Emergency Treatment

In the event of an on-the-job injury, HS-2 will implement required reporting and recordkeeping procedures. The SSHSP describes the actions to be taken by the employee at the time of the injury/illness.

10.0 Decontamination

10.1 Decontamination Plan

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. A site decontamination plan is mandatory. The site decontamination plan shall be part of the SSHSP. At a minimum the plan shall include the step-by-step decontamination procedure and diagrams showing how the decontamination station will be arranged.

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.

10.1.2 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.

10.2 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.

10.2.1 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.

10.2.2 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.

10.3 Equipment Decontamination

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.

10.4 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.

The Laboratory will be responsible for characterization and disposal of chemical wastes generated by its subcontractors during site work under the ER Program.

11.0 Emergencies

11.1 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 and should include specific procedures for dealing with site emergencies in an efficient manner. The emergency response plans also must contain the following elements, as required by OSHA.

1. pre-emergency planning, including map of site to show layout
2. personnel roles, lines of authority, and communication
3. emergency recognition and prevention
4. safe distances and refuge
5. site security and control
6. evacuation routes and procedures
7. decontamination procedures not covered in the SSHSP
8. emergency medical treatment and first aid
9. emergency alerting and response procedures
10. critique of response and follow-up
11. PPE and emergency equipment
12. procedures for reporting incidents to local, states, and federal governmental agencies, both for personnel injuries and property (including vehicle) damage.

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.

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 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.

11.2 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.

11.3 Provisions for Public Health and Safety

Emergency planning for public health and safety is presented in the Laboratory's ES&SH Manual.

11.4 Notification Requirements

Field team members will notify the SSO of emergency situation;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. The Laboratory Health and Safety Division is responsible for implementing notification and reporting requirements according to DOE Order 5484.1.

11.5 Documentation

The will submit a completed DOE Form F 5484.X for any accidents and incidents, according to Laboratory AR1-1.

The HSPL will work with the OUPL and the field team leader to ensure that health and safety records are maintained with the Records Processing Facility as required by DOE orders.

12.0 Personnel Training

12.1 General Employee Training and Site Orientation

All Laboratory employees and supplemental workers must successfully complete Laboratory general employee training (GET)
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.

12.2 Site-Specific Training

Prior to granting site access, personnel must be given site-specific training. Attendance at and understanding of the site-specific training must be documented.

12.3 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.

Radiation protection training is required for all Laboratory employees, contractors, visiting scientists, and DOE and Department of Defense personnel.

12.4 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.

12.5 High Explosives Training

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

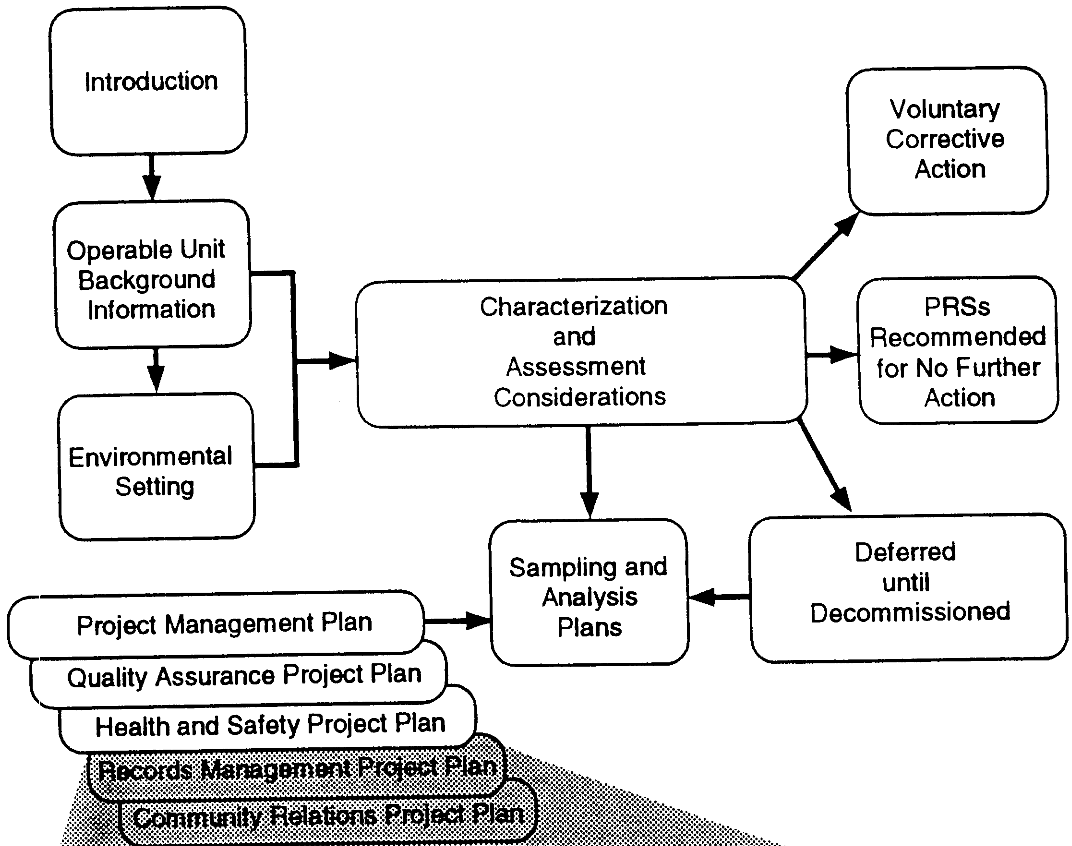
12.6 Facility-Specific Training

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

12.7 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

ANNEX IV



Records Management Project Plan

ANNEX IV: RECORDS MANAGEMENT PLAN

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 1991, 0553). 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 (ref.)] 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).

2.0 Implementation of the Records Management Plan

Chapter 2 of the RMP describes the implementation of the records management program. Records management activities at Operable Unit (OU) 1086 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.

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 1086. 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.

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.

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.

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.

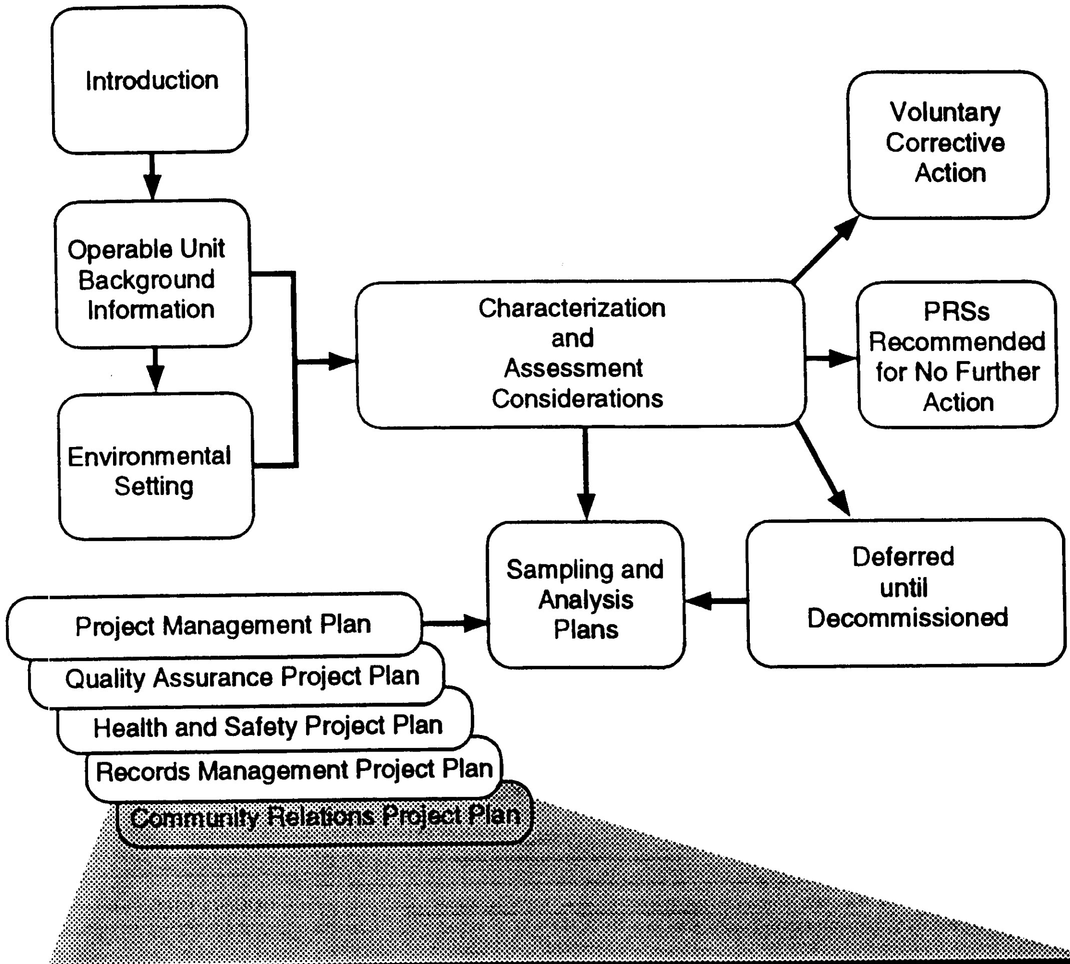
7.0 Coordination with the Community Relations Program

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.

Annex IV Reference

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).

ANNEX V



Community Relations Project Plan

ANNEX V: COMMUNITY RELATIONS PLAN FOR OPERABLE UNIT 1086 (TECHNICAL AREA-15)

1.0 Overview of Community Relations Plan

The Community Relations Plan specific to Operable Unit (OU) 1086 (Technical Area -15, or TA-15) follows the directives, goals, and regulatory requirements set forth in the Community Relations Program Plan in Annex V, Volume 1 of the Installation Work Plan (IWP) (LANL 1991, 0553) for Environmental Restoration (ER). This annex details the community relations activities for OU 1086 during the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI). The activities are based on current knowledge of public information needs and resources available to the Los Alamos National Laboratory (Laboratory) ER Program Staff.

As shown in Figure V-1, public participation is required by regulation during the corrective measures study (CMS); therefore, the Laboratory will provide opportunities for public participation during the RFI process as detailed in this annex and illustrated in Figure V-2. The Hazardous and Solid Waste Amendments (HSWA) module of the Laboratory's RCRA Facility Permit requires that the following specific items be addressed in the Community Relations Plan:

- Establishing a mailing list of interested parties;
- News releases, fact sheets, approved RFI Workplans, RFI final reports, Special Permit Conditions Reports and publicly available quarterly progress reports that explain the progress and conclusions of the RFI;
- Creation of a public information repository and reading room with updates of available material;
- Informal meetings between the public and local officials, including briefings and workshops as appropriate;
- Briefings to address individual concerns and questions;
- Site tours for US citizens at the discretion of the operating group, M4;
- Quarterly technical progress reports during the RFI process for the Administrative Authority; and
- Procedures for immediate notification of the San Ildefonso Pueblo or other neighboring affected parties in the event of a newly-discovered off-site release which could potentially affect them.

These items are addressed in Sections 2.1 through 2.6 of this plan.

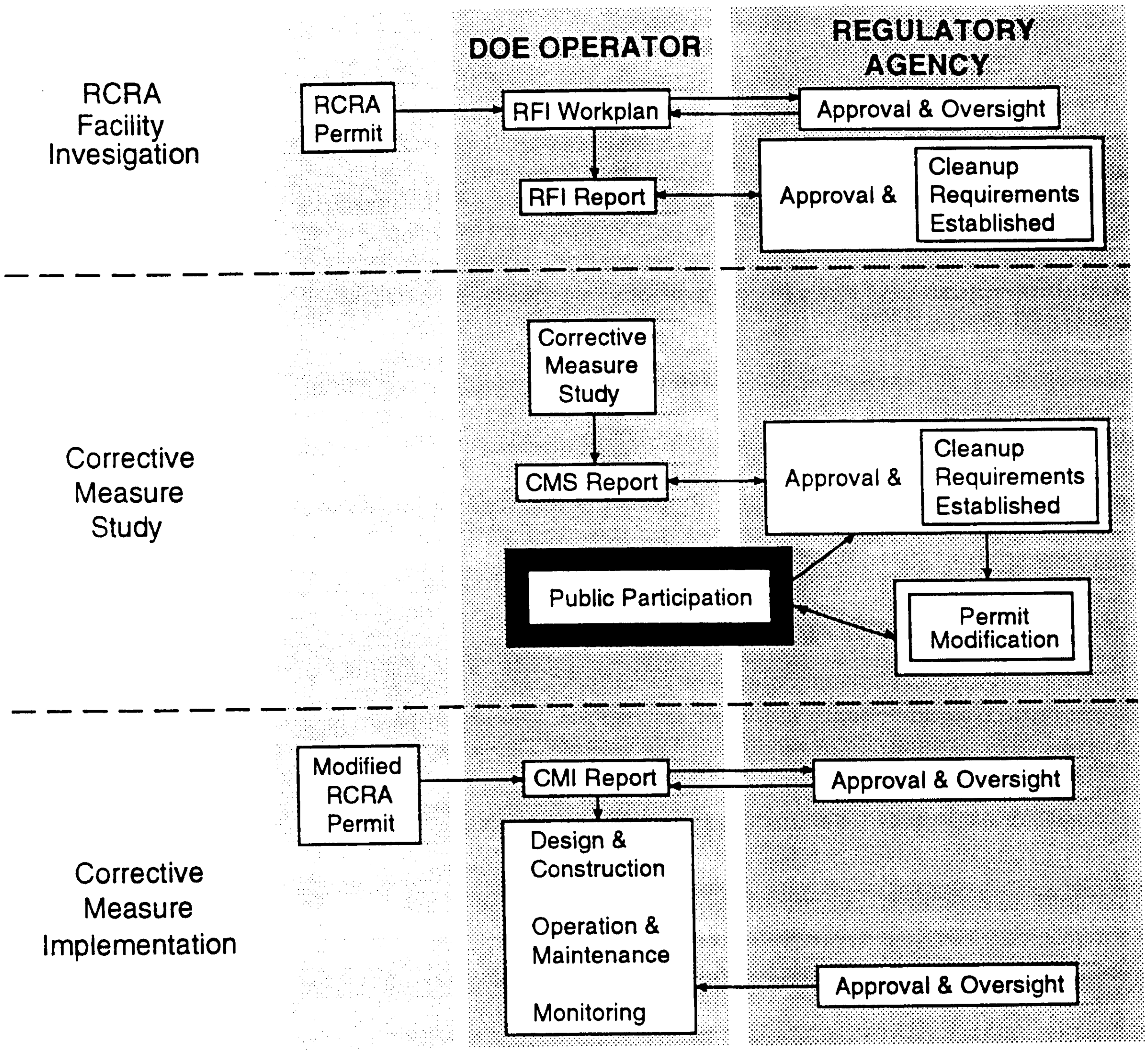


Figure V-1 Regulatory mandated opportunities for public participation during the RCRA corrective action process

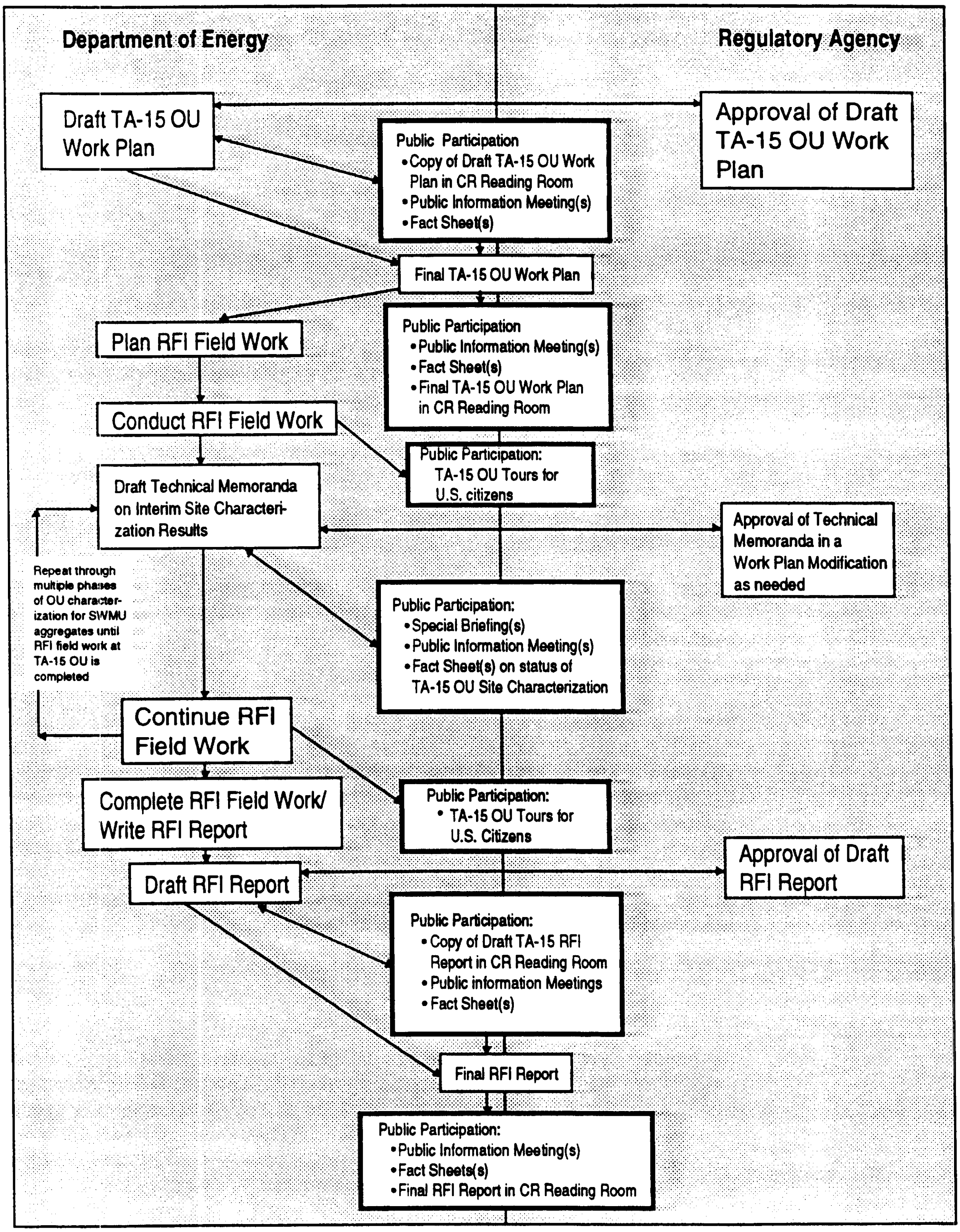


Figure V-2. Opportunities for public participation during the TA-15 OU RFI

All information concerning ER program activities at OU 1086 will originate with or be provided to the public through the community relations project leader as follows:

Community Relations Project Leader
Environmental Restoration Program
Los Alamos National Laboratory
1450 Central Avenue, Suite 101
Los Alamos, New Mexico 87545
(505) 665-2127

2.0 Community Relations Activities

The following is a brief description of community relations activities to be conducted during RFI activities at the TA-15 OU. These activities are designed to address key concerns identified by the TA-15 OU team and IWP. The scope of each activity is flexible and can be tailored to respond to public information needs.

2.1 Mailing List

Community Relations will enhance the ER Program mailing list to include former workers at TA-15 to keep them informed of meetings, activities, and schedules pertaining to the TA-15 OU.

2.2 Fact Sheets

The Community Relations Office developed a fact sheet that shows the TA-15 OU and that summarizes site history and use, known contaminant's of concern, and planned activities (see Attachment 1 to this Annex). The initial fact sheet was distributed in June 1991 and most recently revised in March 1993. Updated fact sheets will be developed as public information needs change and progress is made. A map showing SWMU locations at TA-15 will be available for public review in the ER Program's Public Reading Room.

2.3 ER Community Reading Room

As they are developed, documents and data associated with OU 1086, such as the RFI Work Plan, quarterly technical progress reports, the RFI report, and other reports, will be available to the public at the ER Community Reading Room at 1450 Central Avenue, Suite 101, in downtown Los Alamos, from 9 a.m. to 4 p.m. on Laboratory business days. A copy of the OU 1086 RFI Draft Work Plan will be available at the reading room in July 1993.

2.4 Public Information Meetings, Briefings, Tours and Responses to, Inquiries

There will be public information meetings held in Los Alamos to introduce the public to forthcoming activities described in the work plan for the TA-15 OU. The TA-15 OU Project Leader, with the assistance of the Community Relations Project Leader, will present information and respond to questions and concerns raised by the public. The Laboratory and Department of Energy plan to hold quarterly public information meetings to discuss specific activities and significant milestones during the RFI. Tours will be conducted for interested parties upon request.

If a limited interest issue of concern is raised at a public information meeting, it may be necessary to hold a special briefing or to respond on a one-to-one basis to the inquiry. These inquiries will be coordinated by the Community Relations Project Leader and the TA-15 OU Project Leader.

2.5 Quarterly Technical Progress Reports

As the TA-15 OU RFI is implemented, the Laboratory will summarize technical progress in quarterly technical progress reports, as required by the HSWA module of the Laboratory's RCRA Facility Permit (Task V, C, page 46). These reports will be available at the ER Community Reading Room.

2.6 Informal Public Review and Comment on the Draft OU 1086 RFI Work Plan

The Laboratory will encourage public input regarding the field sampling proposed in the draft TA-15 OU RFI Work Plan after U.S. Environmental Protection Agency (EPA) formal approval of this document following its submittal to EPA in summer 1993.

References for Annex V

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

LANL (Los Alamos National Laboratory), November 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)

Los Alamos
NATIONAL LABORATORY

ENVIRONMENTAL RESTORATION PROGRAM

LOS ALAMOS NATIONAL LABORATORY ER PROGRAM FACT SHEET FOR OPERABLE UNIT 1086 (TA15)

The RCRA Facility Investigation work plan is a document that addresses the site characterization activities for all SWMUs at OU 1086. This document is being submitted to the EPA in July 1993. Characterization activities are scheduled to begin in April 1994 and continue through 1996.

The primary purpose of this work plan is to describe the site characterization activities and verification sampling that will address potential contaminant releases from the SWMUs comprising OU 1086, thus satisfying the regulatory requirements of Hazardous and Solid Waste Amendment Module VIII of the Los Alamos National Laboratory's RCRA Part B Operating Permit.

Acronyms

CMS -	Corrective Measures Study
PHERMEX -	Pulsed, High-Energy, Radiographic Machine Emitting X-Rays
D&D -	Decontamination and Decommissioning
DOE -	U.S. Department of Energy
EPA -	U.S. Environmental Protection Agency
HSWA -	Hazardous and Solid Waste Amendment
OU -	Operable Unit
RCRA -	Resource Conservation and Recovery Act
RFI -	RCRA Facility Investigation
SWMUs -	Solid Waste Management Units
TA -	Technical Area

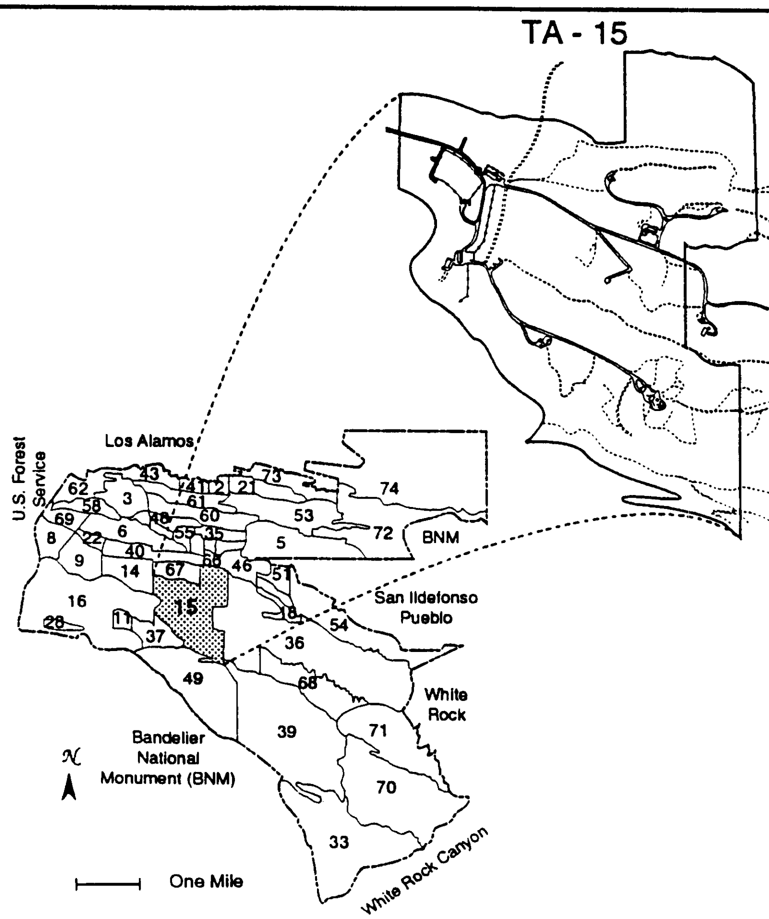
Summary

- Technical Area (TA)-15, or "R" Site consists of a number of firing sites used extensively since 1944 for research and explosive testing of weapon design components. These components were tested, without their fissionable materials, to determine whether actual performance would match design calculations. Such testing leads to safer, more cost-effective systems. TA-15 has specific sites still in present use as firing sites.

- Since 1944, testing at TA-15 involved hazardous and slightly radioactive materials including multikilogram quantities of natural uranium, depleted uranium, beryllium, and lead. These materials may still be present in the surface soil.

- Soil and surface-water samples from the Laboratory's environmental monitoring activity indicate that some of the uranium at one of TA-15's mesa-top firing sites may have been moved by surface-water runoff, or by the explosion itself, to nearby Potrillo canyon.

- Safety at TA-15 is maintained by the enforcement of safe standard operating procedures for experiments, and by strict access restrictions to the technical area and the firing sites.



Purpose of TA-15

Since 1944, TA-15 has been used to research and test the performance of explosive components used in nuclear weapons. Over TA-15's history, about twelve different firing sites have been used, but at present only four sites are actively used. These active sites include the PHERMEX and Ector sites where radiography is used to obtain data on the performance of the explosive assembly during detonation.

Wastes Present at TA-15

Sixty-six potential solid waste management units (SWMUs) have been identified at TA-15, which is designated in the Environmental Restoration (ER) Program as Operable Unit (OU) 1086. Of these SWMUs, the firing sites contain the greatest amount of wastes (multikilogram quantities of natural uranium, depleted uranium, beryllium, and lead). The firing sites also have the greatest potential for contaminant movement by surface-water runoff. An additional small source of contamination comes from wastes from photography laboratories before they were regulated. These mainly consists of silver and organic compounds.

Previous Clean-up Efforts at TA-15

Throughout the history of TA-15, and especially in 1967, numerous structures have been demolished and removed. The firing sites are also routinely swept for any large fragments after each explosion. However, some hazardous materials remain in the soil. On-site health monitoring during the testing allows safe occupational use of the firing sites.

Future Action and Proposed Time Frame

Future action at TA-15 focuses on assessing the extent of contamination and selecting possible remedial actions. Remediation alternatives range from long-term monitoring and institutional controls to excavation and disposal of contaminated soils and vegetation. Future actions are guided by the HSWA module of the Laboratory's RCRA operating permit which specifies the sequence of events by which contaminated areas are identified, characterized, and remediated.

The RFI Work Plan describing the characterization activities will be submitted to the EPA by July 1993. Actual RFI characterization activities are scheduled to be initiated by April 1994.

Reporting

Reports generated during the implementation of this work plan will be made available for review by the public at the ER Community Reading Room in downtown Los Alamos (1450 Central Avenue). The Reading Room is open to the public from 9 a.m. to 4 p.m. on Laboratory business days.

The HSWA Module VIII specifies that certain periodic reports be prepared (i.e., quarterly reports and monthly programmatic status reports) and submitted during the course of the RFI/CMS process. Results of the OU 1086 RFI field investigation will be reported in three principal documents: quarterly technical progress reports; phase reports; and the RFI Report. RFI phase reports, which summarize results of initial site characterization activities and describe any planne follow-up activities, will be generated as SWMUs SWMU Aggregate site characterizations are completed. The RFI phase reports will be approved by EPA prior to proceeding with the subsequent field investigations. At the conclusion of the RFI, the phase reports will be compiled into an overall Final RFI Report due to EPA in September 1998.

Conclusion

Ensuring the safe management of past, present, and future waste requires the cooperation of government, industry, and the public. The Laboratory is committed to providing the public with information about the RFI process such as this fact sheet. The Laboratory will continue to provide information concerning actions taken during investigation and throughout the entire cleanup process. If you have additional questions about TA-15 or about the Laboratory's Environmental Restoration Program, please do not hesitate to call or write:

Community Relations Project Leader
Environmental Restoration Program
Los Alamos National Laboratory
Box 1663, MS M314
Los Alamos, NM 87545
505-665-2127

APPENDIX A

Topographic Map of TA-15, OU 1086

APPENDIX B

Soils Map
TA-15

APPENDIX C

Field and Laboratory Investigation methods

CONTENTS

LIST OF TABLES

APPENDIX C

Field and Laboratory Investigation Methods

C.1 Introduction

C.1.1 Approach

This chapter has been prepared to describe, in one place, the common elements that apply to the conduct of field investigations at all OU 1086 SWMUs. The objectives and technical approach for investigations at the OU 1086 are described in Chapters 1-10 of this work plan. Key concepts presented there include:

1. OU-wide investigations which focus on general environmental characteristics and ambient levels of contaminant indicators. These investigations provide the framework within which SWMU-specific data will be evaluated.
2. SWMU-specific characterization which focuses on the nature and extent of contamination and the potential waste for migration.
3. Identification and planning of explicit phases of investigation.
4. Evaluation of analytical data and reassessment of data needs at intermediate stages (according to the decision analysis and observational approaches).

Listed below are several general concepts that apply to most of the OU 1086 field investigation.

1. Radiological contamination due to uranium and its daughter decay products is a general characteristic of OU 1086 and a primary focus of SWMU-specific investigations.
2. For most OU 1086 SWMUs, release of any hazardous constituents has been associated with the release of the uranium. (Exceptions include photo labs and machine shops, where the contaminants are silver, organics and occasionally chromium from chromic acid.)
3. Field surveys and field screening of samples can be used to identify gross contamination and can serve as Level I/II data.
4. Field laboratory analyses can be used to quickly provide Level II/III data to help guide field operations.

C.1.2 Field Operations

This appendix identifies aspects of the Laboratory's implementation of the RFI that are not duplicated in the SWMU-specific field sampling plans. Such aspects include the standard activities that will be used to support field operations as follows:

- health and safety aspects of field operations,
- Laboratory-required preliminary activities and support procedures,

- identification and documentation of sampling locations,
- sample handling and laboratory coordination procedures,
- equipment decontamination procedures, and
- management of wastes generated by sampling activities.

C.1.3 Investigation Methods

OU 1086 field investigation methods are addressed in Section C.5 (Field Sampling Methods) of this appendix and are tiered to the Laboratory's Installation Work Plan (IWP) (LANL 1991, 0553). The methods presented in this chapter are specific examples of the options identified in the IWP. In addition, this chapter references the Laboratory's ER Program Standard Operating Procedures (SOPs) (LANL 1992, 0411). Each of the brief method descriptions given herein refers to the applicable SOPs for detailed methodology. The methods described in Sections C.4 through C.8 in this chapter include:

- sampling methods;
- field sample screening methods to identify grossly contaminated samples at the point of collection (Level I/II);
- *in situ* field survey methods to identify gross contamination areas and (Level I/II);
- field laboratory measurement methods to provide rapid quantitative or semi-quantitative sample analyses (Level II/III); and
- offsite analytical laboratory methods (Level III).

The method descriptions are brief and provide some specific information that defines the application. More specific information is provided by the individual field sampling plan (such as sampling location or target depth of a borehole). The method descriptions presented here are not intended to supplant or reduce the importance of the Quality Assurance Project Plan (Annex II of this OU work plan) and the governing SOPs (LANL 1991, 0411).

C.1.4 Data Analysis

The final section of this chapter gives a general discussion of data analysis concepts that will be applied in assessing the meaning of collected information. These concepts include (see Section C.10):

- comparisons of sample contaminant levels, to background action, screening levels, and cleanup levels calculated from health-based risk assessment;
- decisions to conduct additional sampling or to stop sampling;
- role of the decision analysis and observational approaches; and
- statistical methods.

C.2 Field Operations

As indicated in the project schedule (Annex I), several investigations, conducted by teams, may be conducted concurrently at OU 1086 provided there is sufficient funding. Each team will have individual responsibilities for health and safety, sample identification, sample handling and chain of custody, and related activities. Other operations may be shared across field teams, such as the field laboratory or an equipment decontamination facility.

A field laboratory will be operated to perform all field laboratory analyses required by the site characterization plans described in Chapters 7 through 10. The field laboratory will be managed independently to assure rigorous QA/QC.

In this section, several aspects of field operations are described that are part of many OU 1086 OU field operations. The applicability of this assumption to each sampling plan in Chapters 7 through 10 is implied and is not restated elsewhere in this OU work plan.

C.2.1 Health and Safety

Annex III of this OU work plan presents the Health and Safety Plan for all field activities for the OU 1086 RFI. The plan gives information regarding known or suspected contaminants (Table III-1) and personnel protection required for different activities. All samples acquired under this work plan will be screened at the point of collection to detect gross contamination or conditions that may pose a threat to the health and safety of field personnel. The techniques listed in Section C.6 of this appendix, Field Sample Screening, will be used. In particular, gross alpha, gross beta, and gross gamma radiation surveys always will be conducted. Applicable SOPs are contained in Chapter 2 of the ER Program SOP document (LANL 1991, 0411).

C.2.2 Archaeological, Cultural, and Ecological Evaluations

Prior to initiation of field work, as part of the Laboratory's ES&H Questionnaire process, archaeological and ecological evaluations will be performed in all areas where the surface is to be disturbed, vegetation is to be removed, or invasive sampling is to be performed. Following the archaeological and ecological evaluations, a DOE Environmental Checklist (DEC) will be issued. It is anticipated that the DEC will lead to a recommendation for a categorical exclusion before RFI field work begins on OU 1086.

C.2.3 Support Services

Physical services support during the field investigation will be provided by Laboratory support groups ENG-3, ENG-5, Johnson Controls, and contractors. Existing job ticket procedures will be used. The services these groups will provide include, but are not limited to, back-hoe 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 working area.

C.2.4 Excavation Permits

As part of the 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 HS-3 and Johnson Controls. Acquisition of excavation permits will be scheduled as appropriate for each phase of field work. All areas intended for excavation, drilling, or sampling deeper than 18 in. will be marked in the field for formal clearance prior to the work.

C.2.5 Sample Control and Documentation

Guidance for sample handling is provided in Section 13 of Annex II of the IWP. Sample packaging, handling, chain of custody, and documentation procedures are provided in the ER Program SOPs as follows:

- General Instructions for Field Personnel
- Containers, Sampling and Preservation
- Guide to Handling, Packaging and Shipping of Samples
- Sample Control and Documentation

C.2.6 Sample Coordination

A Sample Coordination Facility has been established by the ER Program in Laboratory group EM-9 to provide consistency for all investigations. The operation of this facility is detailed in Appendix N of the IWP. The applicable SOP is:

- Sample Control and Documentation

C.2.7 Quality Assurance Samples

Field quality assurance (QA) 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, Quality Assurance Project Plan (QAPjP) of this OU work plan. The frequency with which each type of field QA sample is to be collected also is detailed in the field sampling plans in Chapters 7 through 10, as shown in the sampling tables presented in these chapters.

C.2.8 Equipment Decontamination

Decontamination is performed as a quality assurance measure 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 fluids, including steam cleaning fluids, are considered wastes and must be collected and contained for proper disposal. In the case of firing sites, the decontamination fluids may be deposited back on the SWMU itself. The applicable SOP is:

- General Equipment Decontamination

C.2.9 Waste Management

This discussion is based on the guidance provided in Appendix B of the IWP. Wastes produced during characterization sampling activities may include borehole auger cuttings, excess sample, excavated soil from trenching, decontamination and steam-cleaning fluids, and disposable materials such as wipes, protective clothing, and spoiled sample bottles. In different areas of OU 1086, several of the following waste categories have the potential to be encountered: hazardous wastes, low-level radioactive wastes, and mixed waste. Requirements for segregating, containing, characterizing, treating, and disposing of each type and category of waste are provided in the applicable SOP:

- RFI-Generated Waste Management

C.3 Standard Survey, Screening, and Analytical Tables

For the purpose of implementing all sampling plans of this RFI work plan, a standard table has been developed which identifies certain field operations and sample analytical requirements. Table C.3-1 is an example of one of these tables.

C.3.1 Samples and Sampling Methods

The four columns on the left side of Table C.3-1 identify the sampling or activity to be conducted, the sampling location, and the depth interval (as appropriate), and the sample identification number. The sampling methods or activities identified in the first column are specifically defined below in Section C.5 Field Sampling Methods.

TABLE C.3-1

EXAMPLE OF A SAMPLE SCREENING AND ANALYSIS TABLE

				Field Screening						Field or Off-Site Laboratory Measurements									
Sample Type	Sampling Location	Interval	Sample Identification	Gross Alpha	Gross Beta	Gross Gamma	Lead	HE	VOC	Gross Alpha/Beta	Gamma Spectrometry	Total Uranium	Lead	Beryllium	Mercury	Silver	Chronium	HE	SVOC (SW 8240)
	1	0.0 - 6.0 In		1	1	1	1			1	1	1	1	1	1			1	
	2	0.0 - 6.0 In		1	1	1	1			1	1	1	1	1	1			1	
	3	0.0 - 6.0 In		1	1	1	1			1	1	1	1	1	1			1	
	4	0.0 - 6.0 In		1	1	1	1			1	1	1	1	1	1			1	
	5	0.0 - 6.0 In		1	1	1	1			1	1	1	1	1	1			1	
	6	0.0 - 6.0 In		1	1	1	1			1	1	1	1	1	1			1	
	7	0.0 - 6.0 In		1	1	1	1			1	1	1	1	1	1			1	
	8	0.0 - 6.0 In		1	1	1	1			1	1	1	1	1	1			1	
	9	0.0 - 6.0 In		1	1	1	1			1	1	1	1	1	1			1	
	10	0.0 - 6.0 In		1	1	1	1			1	1	1	1	1	1			1	
	11	0.0 - 6.0 In		1	1	1	1			1	1	1	1	1	1			1	
	12	0.0 - 6.0 In		1	1	1	1			1	1	1	1	1	1			1	
	13	0.0 - 6.0 In		1	1	1	1			1	1	1	1	1	1			1	
	14	0.0 - 6.0 In		1	1	1	1			1	1	1	1	1	1			1	
	15	0.0 - 6.0 In		1	1	1	1			1	1	1	1	1	1			1	
	16	0.0 - 6.0 In		1	1	1	1			1	1	1	1	1	1			1	
	17	0.0 - 6.0 In		1	1	1	1			1	1	1	1	1	1	1	1	1	1
	18	0.0 - 6.0 In		1	1	1	1			1	1	1	1	1	1	1	1	1	1
	19	0.0 - 6.0 In		1	1	1	1			1	1	1	1	1	1	1	1	1	1
	20	0.0 - 6.0 In																	
QA/QC (Soil)																			
Rinsate blank		0.0 - 6.0 In		1	1	1	1			1	1	1	1						1
Field duplicate		0.0 - 6.0 In		1	1	1	1			1	1	1	1						1
Field blank		0.0 - 6.0 In		1	1	1	1			1	1	1	1						1
Total number of screenings and analyses:				23	23	23				23	23	23	23						6

C.3.2 Survey, Screening and Analysis Methods

Consistent language has been adopted in this work plan to refer to five categories of measurements as defined below, to avoid confusion regarding the type of measurement being discussed.

1. Field Surveys (or "surveys"). Direct reading or recording instruments are used to scan the land surface to make measurements of *in situ* conditions. Typically, surveys provide Level I or II data. Gamma radioactivity is a common target of field surveys. Land surveys, geophysical surveys and borehole logging also are included in this category.
2. Field Screening ("field sample screening" or "screening"). Instruments or observations are applied to samples at the point of collection to measure the presence of gross contamination or determine other properties of the sample. Usually, screening provides Level I data. Alpha radioactivity is a common target of field screening.
3. Field Laboratory Measurements (or "field laboratory analyses"). These are sample analysis methods that require minimal sample preparation and are readily adaptable to mobile laboratory analytical equipment. These methods measure contaminants or other sample properties at better detection limits, with better precision, or for different contaminants than can be obtained with field screening techniques. Level II data are common, although Level I and Level III procedures are also used. Gross alpha/beta and gamma spectrometry measurements on dried soil samples is a typical example.
4. Offsite Analytical Laboratory Analysis. This category represents the primary analysis for which samples are collected, preserved, and sealed. Level III or IV data usually result. Analysis for RCRA metals is a typical application.
5. Special Analysis (This category represents analyses which require special methods such as, low-level isotopic plutonium.)

In Table C.3-1, for each category of measurements, several measurement techniques are identified by vertical columns. These represent the techniques that will be used most commonly for OU 1086 RFI samples. The individual measurement techniques represented by each vertical column are identified in the following sections of this appendix: Section C.4, Field Surveys; Section C.6, Field Sample Screening; Section C.7, Field Laboratory Measurements; and Section C.8, Offsite Laboratory Analysis.

C.3.3 Use of the Standard Screening and Analysis Table

The standard survey, screening, and analysis tables will serve two major purposes. First, the tables will clearly and concisely summarize the details of each sampling plan. These will give sampling locations, indicates methods and intervals, and identifies the survey, screening, and analysis measurements for each sample as detailed in Chapters 7 through 10. The tables will explicitly identify the collection and analysis of field quality assurance samples. The tables also will provide much of the detail needed to estimate the costs of the investigation.

The table will identify the sample selection and the number of samples, generally one (1) is shown. Included are quality control samples. Implicit in these sample tables is the understanding that the numbers may change as a result of the field laboratory measurements.

C.3.4 Indicator Analytes

In most of the OU 1086 SWMU sampling plans, the following limited set of analytes will be used to indicate the presence or absence of contaminants:

- gamma spectrometry
- gross alpha/beta radioactivity
- total uranium
- selected RCRA metals, usually beryllium and lead, and occasionally mercury, silver, and chromium
- high explosives

The specific analytical methods are defined in Section C.8, Laboratory Analysis.

C.3.5 Additional Analyses

For certain PRSs, additional analyses are appropriate beyond those listed above. Blank columns are provided in Table C.3-1 for listing other additional analyses required at particular PRSs.

C.4 Field Surveys

Field surveys (defined above in Section C.3.2) typically are primarily scans of the land surface using direct reading or recording instruments. For this OU work plan, these surveys include radiological and some geophysical surveys to identify and refine locations such as for MDA-N, SWMU 15-007(a) as indicated by other information and to identify the presence or absence of contaminants or structures in the field. In some plans, these techniques are used to identify locations for judgemental sampling. In other plans, they are used for preliminary assessment of areas where contaminants are not expected. While negative field survey results are not necessarily conclusive evidence of the absence of contaminants, they can greatly minimize the probability that gross contamination has been overlooked and can allow timely redirection of field sampling.

C.4.1 Radiological Surveys

Radiological survey methods are addressed in Appendix G of this OU work plan.

C.4.2 Geophysical Surveys

Field surveys will be performed with an electromagnetic instrument to confirm the location of buried structures such as shafts and landfills and to trace the path of buried metallic material such as piping. The selected geophysical instrument will be able to detect all types of metal (ferrous and nonferrous) and will be capable of detecting a 2-in.diameter metal line buried at a depth of 5 ft. A geophysical survey to locate buried metal lines is typically performed by continuously observing the instrument meter response while walking along traverse lines that cross at a right angle over the suspected trend of the buried line. A typical spacing of the parallel traverse lines is 20 ft. A geophysical survey to locate buried metal structures is typically performed by taking measurements on a grid established over the suspected location of the structure. The spacing for measurements is determined by the size of the structure; the required spacing may be as close as measurements taken at nodes on a 2.5- by 2.5-ft grid. Additional geophysical survey methods, such as resistivity and seismic, will be utilized if appropriate. The applicable SOP is:

- General Surface Geophysics

C.4.3 Land Surveys

Land surveys will be used to document all sampling locations and to locate either former or buried structures (where needed). Because sampling location surveys will be done for all sampling points, it is not specifically identified in the analytical table. In all cases, the minimum precision requirements for the surveys are the same: plus or minus 1-ft horizontal and vertical. The conventional survey procedures used are documented by Laboratory Facilities Engineering organizations.

C.5 Field Sampling Methods

C.5.1 Introduction

For the field sampling plans used in this work plan, a suite of specific sampling methods has been selected, and the details of their use and application in the field have been defined. For example, a "surface soil sample" in this document is specifically defined as representing a 0 to 6 in. layer of soil collected by a hand scoop (see Subsection C.5.2.1), and a subsurface sample is a soil sample collected from 6 to 24 in. in depth.

Setting these common definitions and using them uniformly in all of the OU 1086 OU field sampling plans provides several benefits:

consistency of field operations, comparability of sample analysis results from location to location, and the ability to have each sampling plan refer to a method defined in this chapter without reproducing the information in each plan. For each method identified below, the specifically defined portion is detailed. However, complete specification of the method requires additional information that is referenced to the applicable SOP or provided in the field sampling plan (e.g., nominal or target depth for a borehole).

C.5.2 Soil Sampling Methods

C.5.2.1 Surface Soil Sample

Surface soil samples are defined as samples taken from the first 6 in. of soil. This type of soil sample will be gathered using a stainless steel or Teflon scoop. Care will be used to take the sample to a full 6 in. depth and to cut the sides of the hole vertically to ensure that equal volumes of soil are taken over the full 6-in. depth the applicable SOP is:

- Spade and Scoop Method

C.5.2.2 Subsurface Soil Sample

To obtain subsurface soil samples to depths of about 24 in., the spade-and scoop method will be used. Spades and shovels are used to remove surficial material to the required depth and a stainless steel or Teflon scoop is used to collect the sample. Care will be used to take the sample to the full depth and to cut the sides of the hole vertically to ensure equal volumes of soil are taken over the full 6 in. depth. Unless otherwise specified, the sample interval will be 6 in. Devices plated with chrome or other materials are not acceptable for sample collection. The applicable SOP is:

- Spade and Scoop Method

C.5.2.3 Undisturbed Surface Soil Sample

Undisturbed soil samples will be gathered from the first 6 in. of soil using the ring sampler method. This method involves driving a 4-in.-diameter stainless steel tube (ring sampler) vertically into the area to be sampled. The soil around the ring sampler is then excavated so that the tube can be removed. An undisturbed core sample is obtained by pushing out the soil in the ring sampler. The applicable SOP is:

- Stainless Steel Surface Soil Sampler

C.5.2.4 Manual Shallow Core Sample

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. Usually it is not practical to use a hand auger or thin-wall sampler at depths below 10 ft. The applicable SOP is:

- Hand Auger and Thin-Wall Sampler

C.5.3 Shallow Boreholes

Several OU 1086 sampling plans call for core samples to be collected from shallow boreholes limited to depths down to the tuff centerface where minimal penetration of contaminants is expected. For ease of setup and rapid drilling of shallow boreholes, the use of a light-weight drilling rig or a "driven-casing" system may be preferred over other methods.

The stopping criterion described in Section C.5.3 will be used as appropriate and the applicable SOP for shallow boreholes is:

- Hollow-Stem Auger

C.6 Field Sample Screening

Field screening is defined earlier in Subsection 3.2. Screening measurements are applied to samples and the point of surface sample collection, to assess conditions affecting the health or safety of field personnel. Application of screening for personnel health and safety is detailed in Annex III (Health and Safety Project Plan) of this OU 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 indicate the measurement to be made. In general, every sample taken at OU 1086 will be screened for gross alpha, beta, and gamma radioactivity.

In addition to the role of sample screening in monitoring for gross contamination or other health and safety concerns, some OU 1086 OU sampling plans use the sample screening information explicitly as Level I data for making decisions on further sampling, or for selecting sample analysis options.

C.6.1 Radiological Screening

C.6.1.1 Gross Alpha

Field screening of samples for gross alpha contamination is conducted using a hand-held alpha detector and a ratemeter. The detector is held close to the sample and is capable of detecting approximately 100-200 counts per minute for an undried sample. The instrument cannot identify specific radionuclides. The applicable SOP is:

- Total Alpha Surface Contamination Measurements

C.6.1.2 Gross Gamma and Gross Beta

Field screening of samples for gamma radioactivity will be done using a hand-held gamma detector probe and ratemeter as a gross indicator of potential contamination. 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. The applicable SOP is:

- Measurement of Gamma Radiation Using a Sodium Iodide (NaI) Detector

C.7 Field Laboratory Measurements

The scope and nature of field laboratory measurements to be used in support of investigations at OU 1086 are defined in this section. The field laboratory will provide fast turn-around analysis of samples for a limited number of analytical methods. The techniques used in the field laboratory give primarily Level II data, although some are Level I or Level III methods as noted below. The field laboratory methods provide better quality information or lower detection limits than can be obtained with field screening or survey. In some cases, they provide a type of information that cannot be obtained with field screening or survey techniques. The intended uses of the field laboratory results are:

1. Guidance to Field Operations. The use of a field laboratory can provide fast turn-around results to aid in directing the course of field work, thus increasing the efficiency of field operations.
2. Judgemental Sample Selection. Field laboratory analyses of knowledge-based (judgemental) samples can enhance the effectiveness of the investigation. Based on field laboratory analyses, additional samples having particular characteristics can be selected:
   - those with no detectable contaminants to define the edge of a plume;
   - those with the highest levels, to identify contaminants during source characterization.
3. Analytical Sample Load Reduction. Field laboratory provides the capability to quickly and inexpensively assess samples for selected analytes. As a consequence, the submittal of a smaller number of samples to an off-site analytical laboratory can be justified by a base of lower quality measurements. This approach provides assurance that high quality measurements are representative and sufficient for decision making and can limit the number of samples that must be sent for more costly analysis at an offsite analytical laboratory.
4. Set Department of Transportation requirements for packaging, etc.
5. Establish that analytical laboratory limits for samples will not be exceeded.

The selection of samples to be submitted to an offsite analytical laboratory, based on field laboratory results, is required in the OU 1086 OU field investigation. The criteria to be used for making this selection depend on the focus and goals of the particular investigation, described in the PRS-specific sampling plans (Chapters 7 through 10 of this OU work plan).

C.7.1 Radiological Measurements

C.7.1.1 Gross Alpha and Gross Beta Radioactivity

Measurements of gross alpha and beta radioactivity can be used to assess the presence of plutonium, uranium, and americium in samples, although identification of the individual radionuclides is not possible by this method. However, uranium is the only metal of these three expected on OU 1086. These Level II measurements can be used to guide field operations or to bias sample selection.

The method uses a thin-walled NaI detector and dried soil samples in a fixed geometry. A measurement time of approximately 15 to 20 min is typical. Detection limits are approximately 4-10 pCi/g for alpha emitters and 5-12 p/Cig for beta emitters. Additional detail is given in Annex II of this OU work plan and in the ER Program Generic QA Plan. The applicable SOP is:

- Screening Soil Samples for Alpha Emitters

C.7.1.2 Gross Gamma Radioactivity

Gross Gamma radioactivity will be determined to find the total amount of gamma emitters.

Gamma spectrometry can be used to quantify gamma-emitting radionuclides in soil samples. Rapid turn-around analysis can be Level II or Level III quality using personal computer-based, multichannel analyzers (MCA) and NaI or germanium photon detectors. An example is a Canberra MCA with a Ludlum 44-10 NaI detector, although many equivalent instruments are available. Dried soil samples in fixed geometries can be analyzed in approximately 20 to 30 min with a detection limit of about 5 pCi/g for radionuclides such as Cs-137 (detection limits are isotope-specific). The applicable SOP is:

- Use of Gamma Spectrometry Systems as a Screen for Gamma Ray-Emitting Radionuclides in Soil Samples

C.7.2 Metals

X-Ray fluorescence analysis can be used in the field for a rapid turn-around analysis for many metals, including uranium, lead, mercury, chromium, and silver.

Laser induced breakdown spectroscopy can be used in the field for beryllium determinations.

C.7.3 High Explosives

Field screening for high explosives (HEs) will employ the Baytos spot test for HEs (Baytos 1991, 0741).

C.7.4 Organic Chemical Measurements

C.7.4.1 Volatile Organic Compounds

To guide field operations (primarily drilling), rapid turn-around Level II analysis might be needed to identify and quantify volatile organic compounds (VOCs). The Laboratory's transportable purge-and-trap GC/MS can provide qualitative and quantitative analyses of most VOCs with boiling points below 200 degrees Celsius that exhibit low or slight solubility in water. Volatile water-soluble compounds also can be detected with higher detection limits. The applicable SOP is:

- Portable Gas Chromatography for Field Screening of Volatile Organic Compounds

C.8 Offsite Laboratory Analysis

In Subsection C.3.2, laboratory analysis levels are defined as they are used in this OU work plan. Offsite laboratory analysis are intended to provide the highest quality (Level III/IV) data required. As described in Subsection C.2.6, samples to be submitted to an offsite analytical laboratory will be coordinated, handled, and tracked by the ER Program Sample Coordination Facility. The standard list of analytes and quantification limits is given in Annex II of this OU work plan and in the ER Program Generic QA plan. Standard commercial laboratory procedures will be modified as described in Section C.7.1 and Annex II of this OU work plan.

Some OU 1086 OU sampling plans rely exclusively on Level III data to support their objectives. Other plans use Level I/II data for field guidance and use the higher quality results for limited purposes. As discussed in Section C.3, the standard survey, screening and analysis tables identify the analyses for which each sample is submitted. Identification of methods frequently listed in the standard table follows.

Gamma Spectrometry. Radionuclides are quantified by measurement of gamma ray photon emissions. Pertinent to this OU work plan, this method yields the levels of gross gamma radioactivity.

Total Uranium. Analysis will be done by LANL HSE-9 methods following sample digestion using EPA method 3050.

Semivolatile Organics (SVOCs). The EPA standard method (SW 8270) will be used to quantify semivolatile organic compounds.

Selected RCRA Metals. The EPA standard method (SW 6010) will be used to quantify the following metals;

uranium, beryllium, lead, mercury, silver, and chromium

C.9 Data Analysis

Several aspects of data analysis are integral to the use of the phased investigation and decision analysis approaches described in the IWP and in Chapter 4 of this OU work plan. An overview of several aspects of data analysis pertinent to the OU 1086 is given below.

C.9.1 Phased Sampling

Phased sampling involves the initial collection of one set of samples and/or data with the results of measurements from this first set used to determine if additional sets of samples are required. Thus results from the initial investigation guide the selection of subsequent sampling. Although unbiased estimates of population parameters can be based on a single set of samples, efficient and cost-effective data practice entails the use of the first set of samples to determine the number of additional samples and their optimum locations for the required accuracy of the estimates. Subsequent sampling is used to give a more detailed characterization of the area, if required, and to confirm the predictions and parameter estimates of the earlier stages.

The phased approach has been used to guide sample or data collection and chemical analysis for the OU 1086 RFI to the extent possible. Analytical results for the first set of the samples collected will be evaluated to determine if further analysis is necessary and to provide guidance for minimizing required analyses on subsequent samples.

Decisions to Conduct Additional Sampling. Within some of the individual sampling plans, options are presented to expand the scope of sampling based on immediate information from field surveys, sample screening, and field laboratory measurements. These options allow the area covered by a sampling program to be adjusted.

After review and evaluation of analytical data from initial sampling, a decision to conduct subsequent investigations will be based on a need to further characterize contaminant concentrations, vertical and lateral extent, or migration along particular pathways, dependent upon objectives of the given PRS investigation.

Decisions Not to Conduct Additional Sampling. Characterization investigations may be terminated on the basis of one of several criteria as follows:

1. At many PRSs, contamination is unlikely to exist above cleanup levels or even background or action levels. In a number of these cases, initial results will be sufficient to determine that no significant contamination is present and that no further action is necessary.

2. In some cases, data from initial characterization may identify significant levels of contamination, but the nature and probable extent of contamination may indicate an easily remediated situation. A commonly encountered example is collected piles of soil and debris or soil hot spots. In such cases, it may be judged more appropriate to remove the contamination as a voluntary corrective action than to do further characterization.
3. Initial characterization may identify waste types or contaminant situations for which the most appropriate approach is the conduct of a pilot study to assess options for treatability or remedial alternatives.
4. Further characterization may be curtailed so that effective planning of a corrective measures study can provide additional guidance.

Decision Analysis Approach. In all of these situations, the decision analysis approach, described in Appendix I of the IWP, will be used to ensure that the decision-making process, with regard to additional characterization sampling, will be systematic. This will be documented by formal reports of data assessment.

REFERENCES FOR APPENDIX C

ASTM (American Society for Testing and Materials) 1946. Annual Book of ASTM Standards, Philadelphia, Pennsylvania. (ASTM 1946, 0743)

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), May 1991. "Environmental Restoration Standard Operating Procedures," Vols. I, II, and III, Los Alamos, New Mexico. (LANL 1991, 0411)

APPENDIX D

Engineering Drawings
TA-15

APPENDIX D CONTENTS

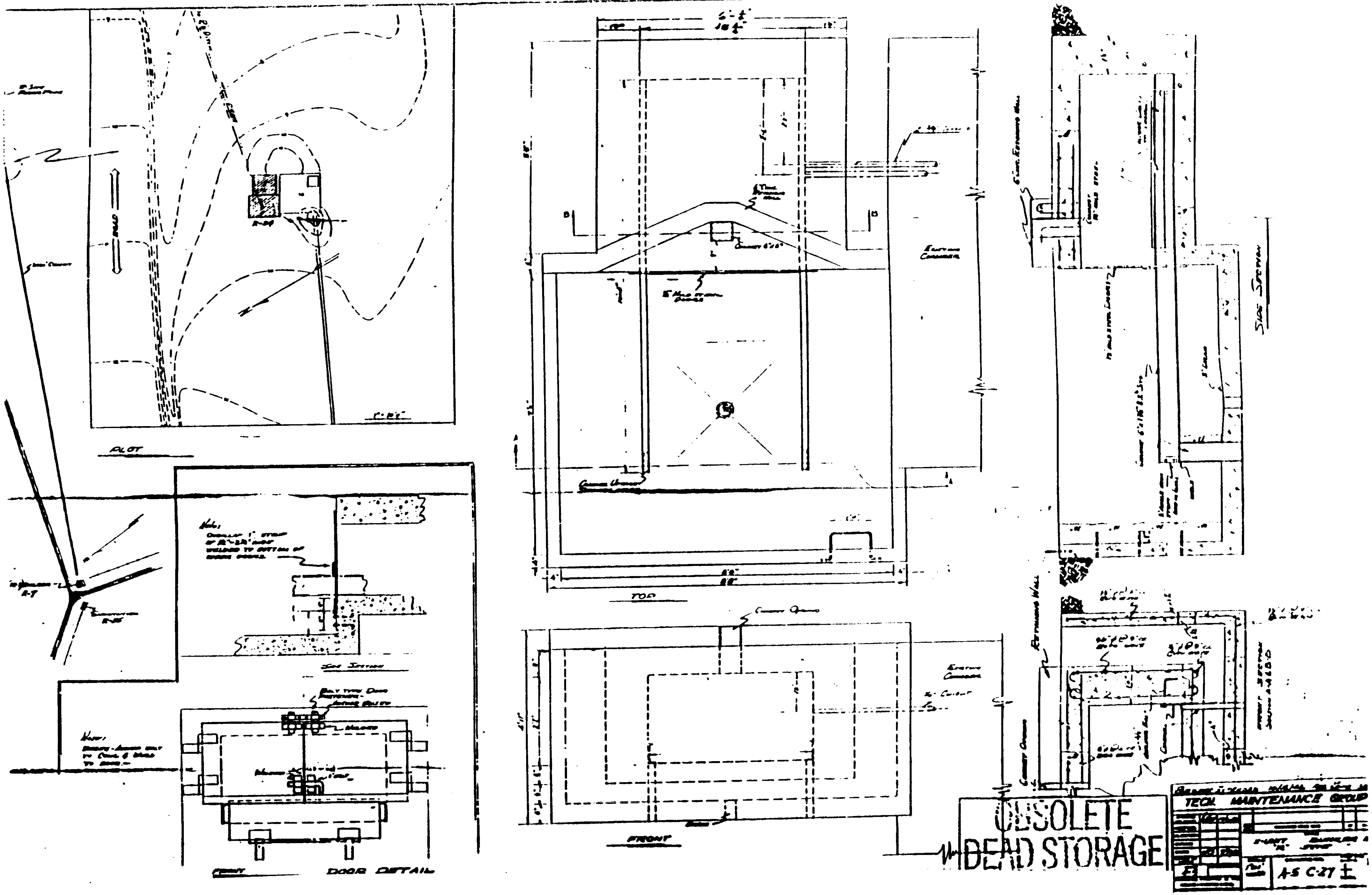


Figure D-1 Bunker in R Site, TA-15 (A-5 C-27)

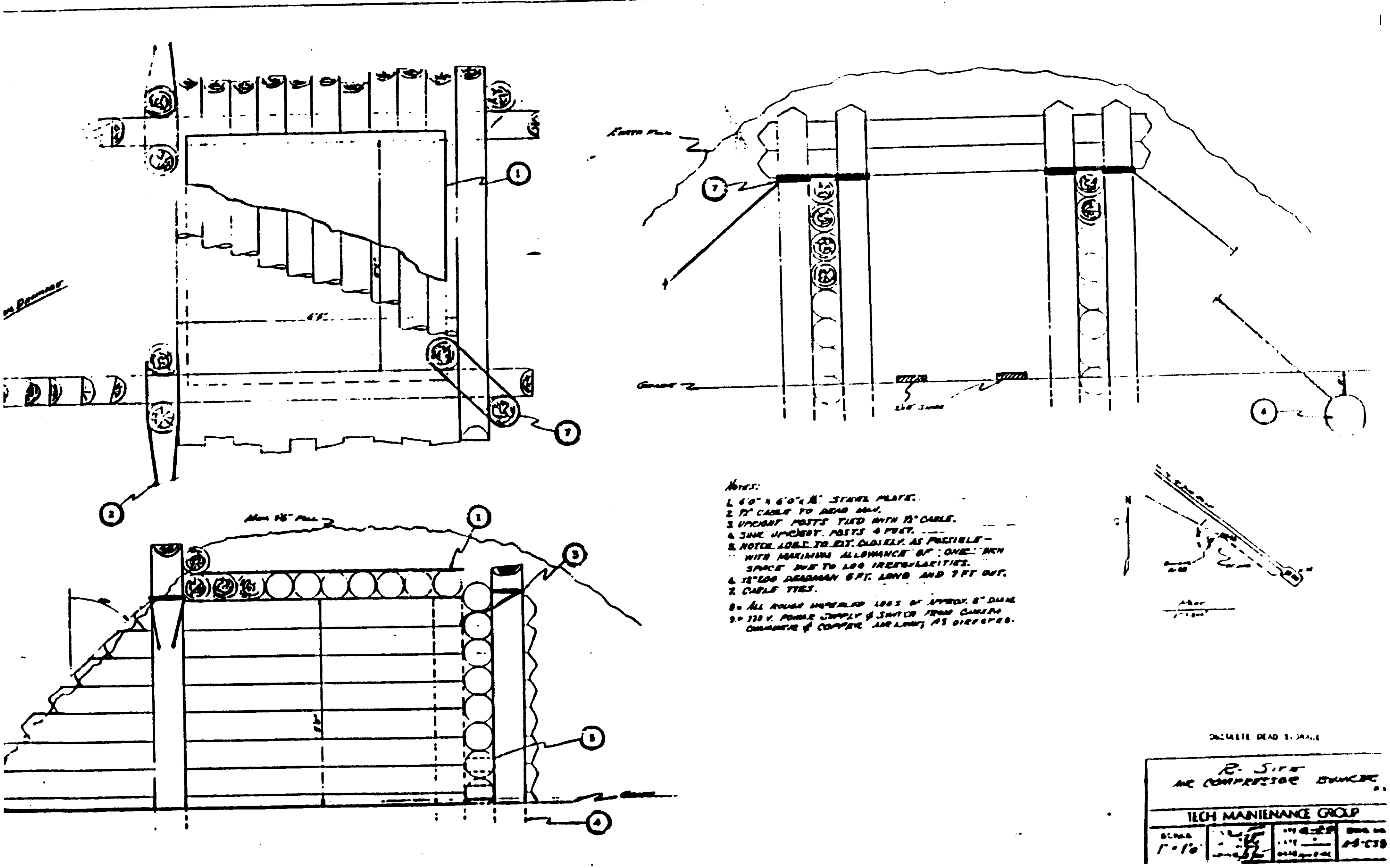


Figure D-2 R Site Air Compressor Bunker (A-5 C-39)

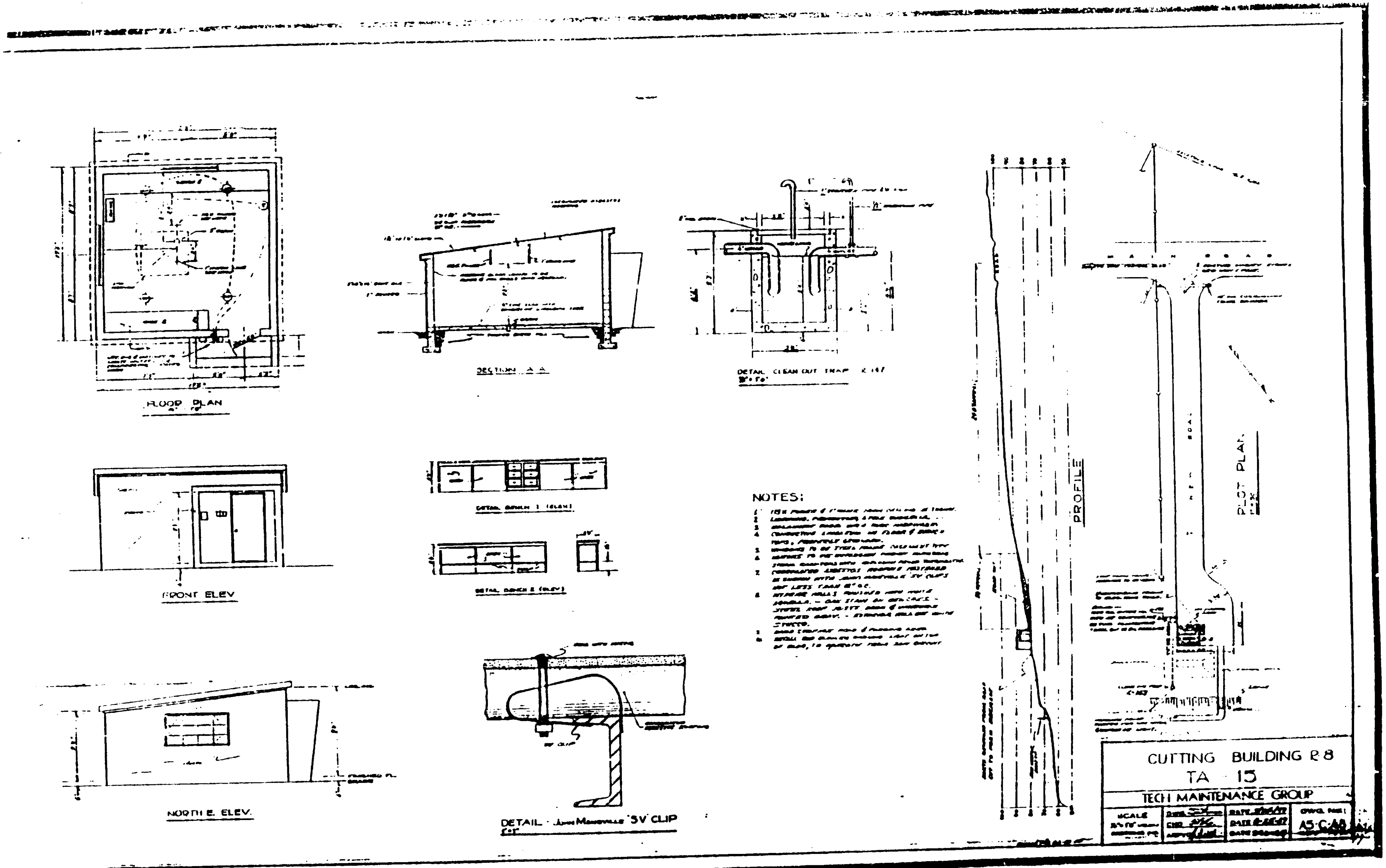


Figure D-3 Cutting Building R-8, TA-15 (A-5 C-48)

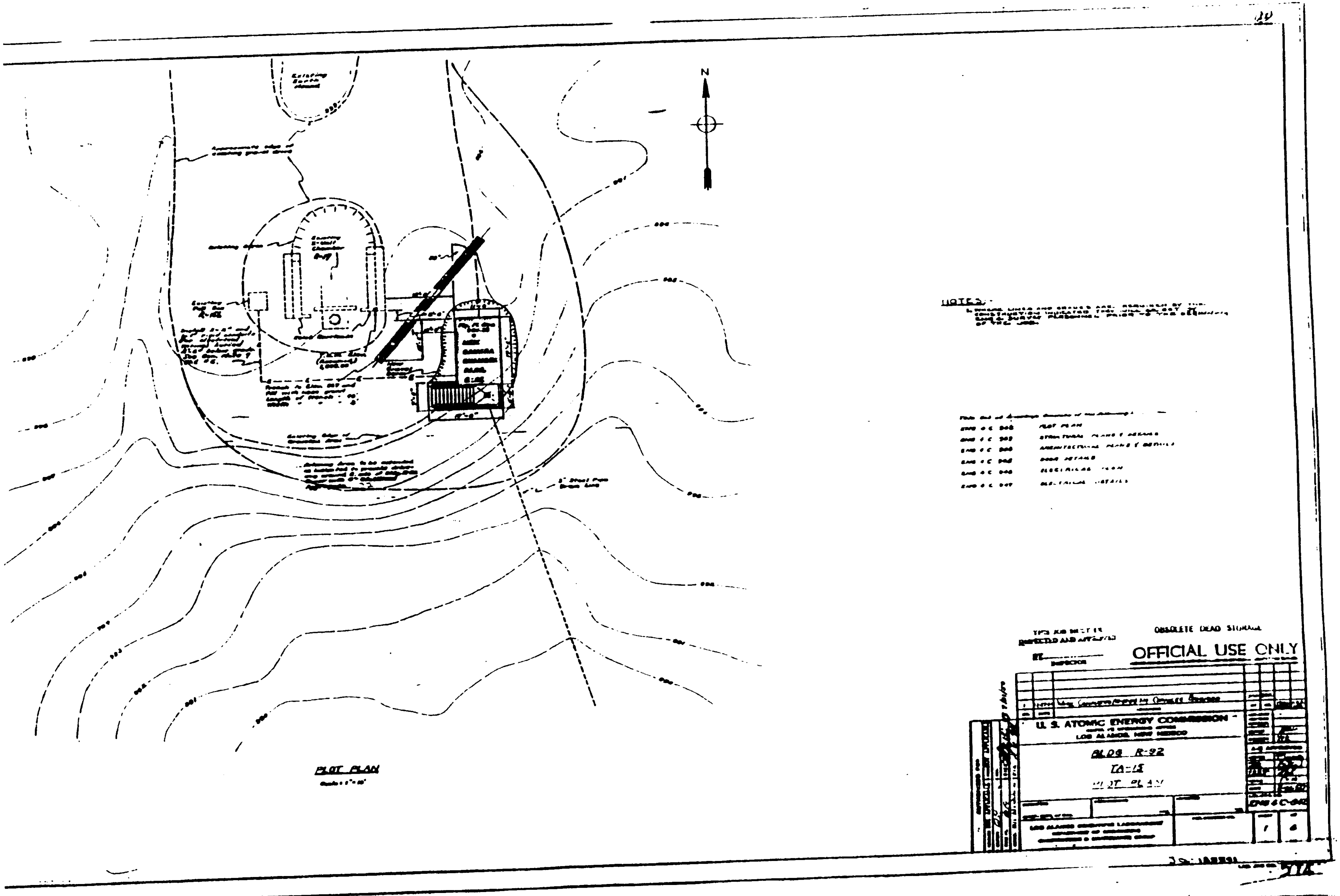


Figure D-4 Plot Plan, Building R-92, TA-15 (ENG 4 C-942)

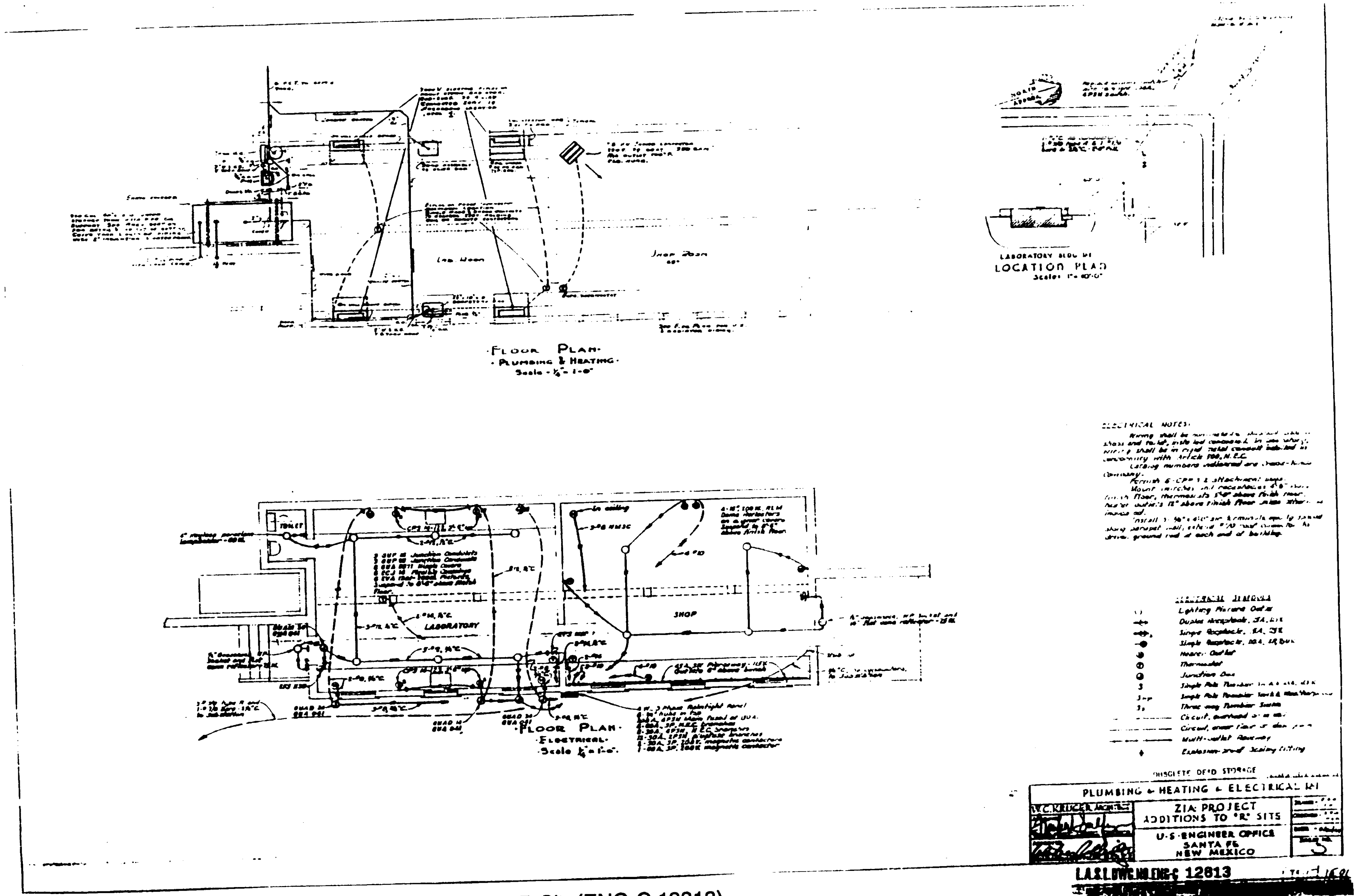


Figure D-5 Zia Project Additions to R Site(ENG-C 12813)

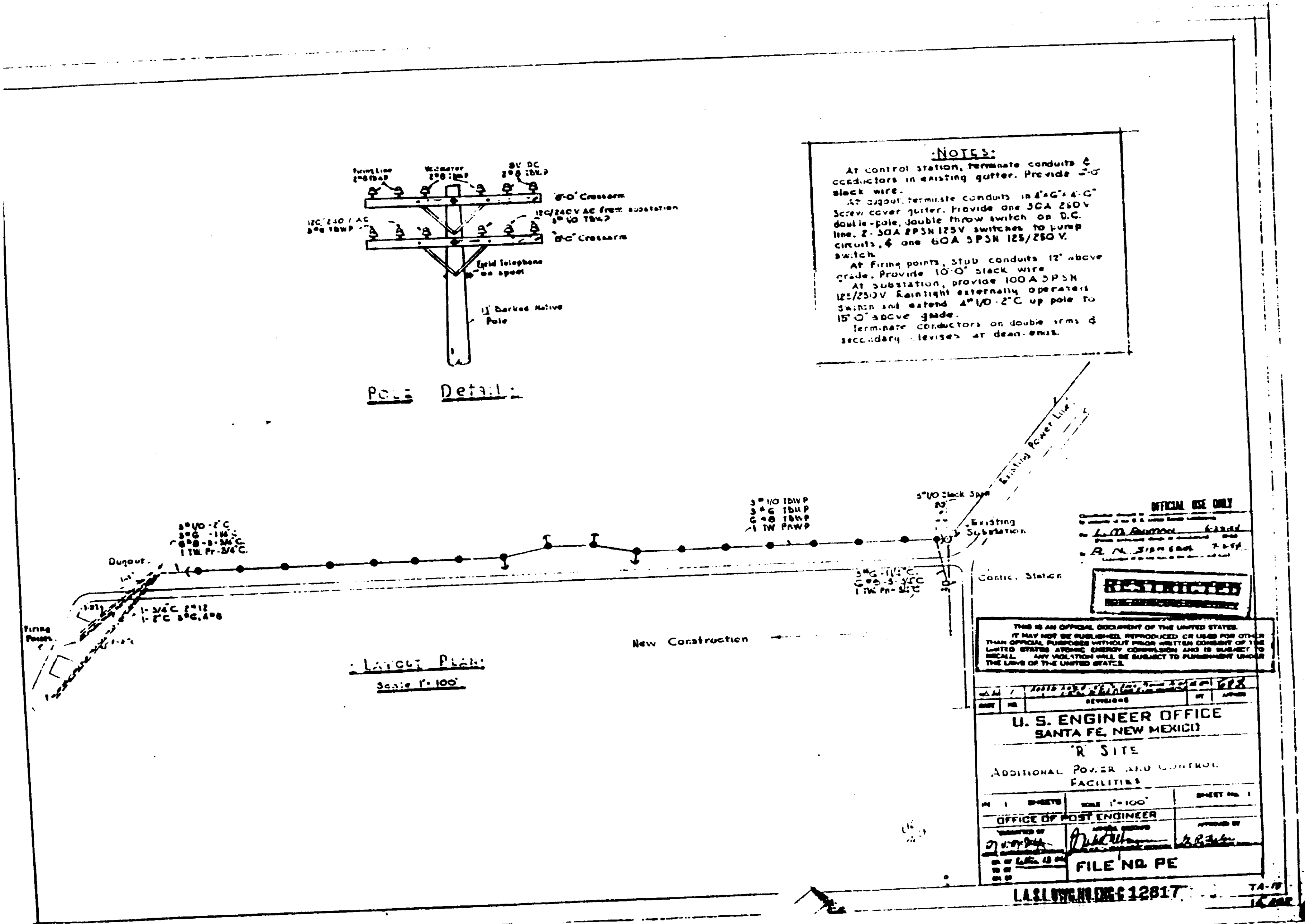


Figure D-6 R Site Additional Power and Control Facilities (ENG-C 12817)

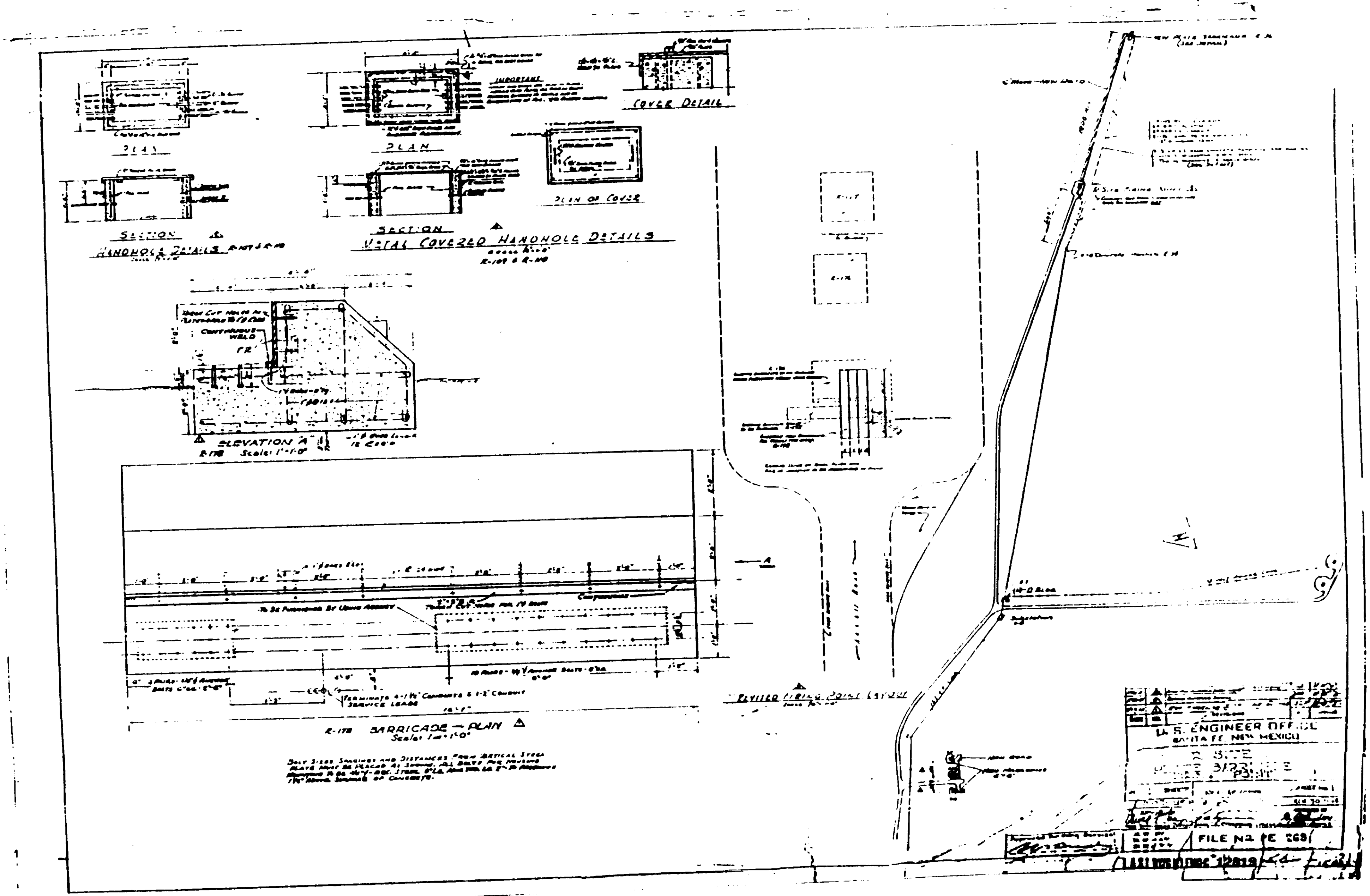


Figure D-7 R Site Plate Barricade Firing Point (ENG-C 12819)

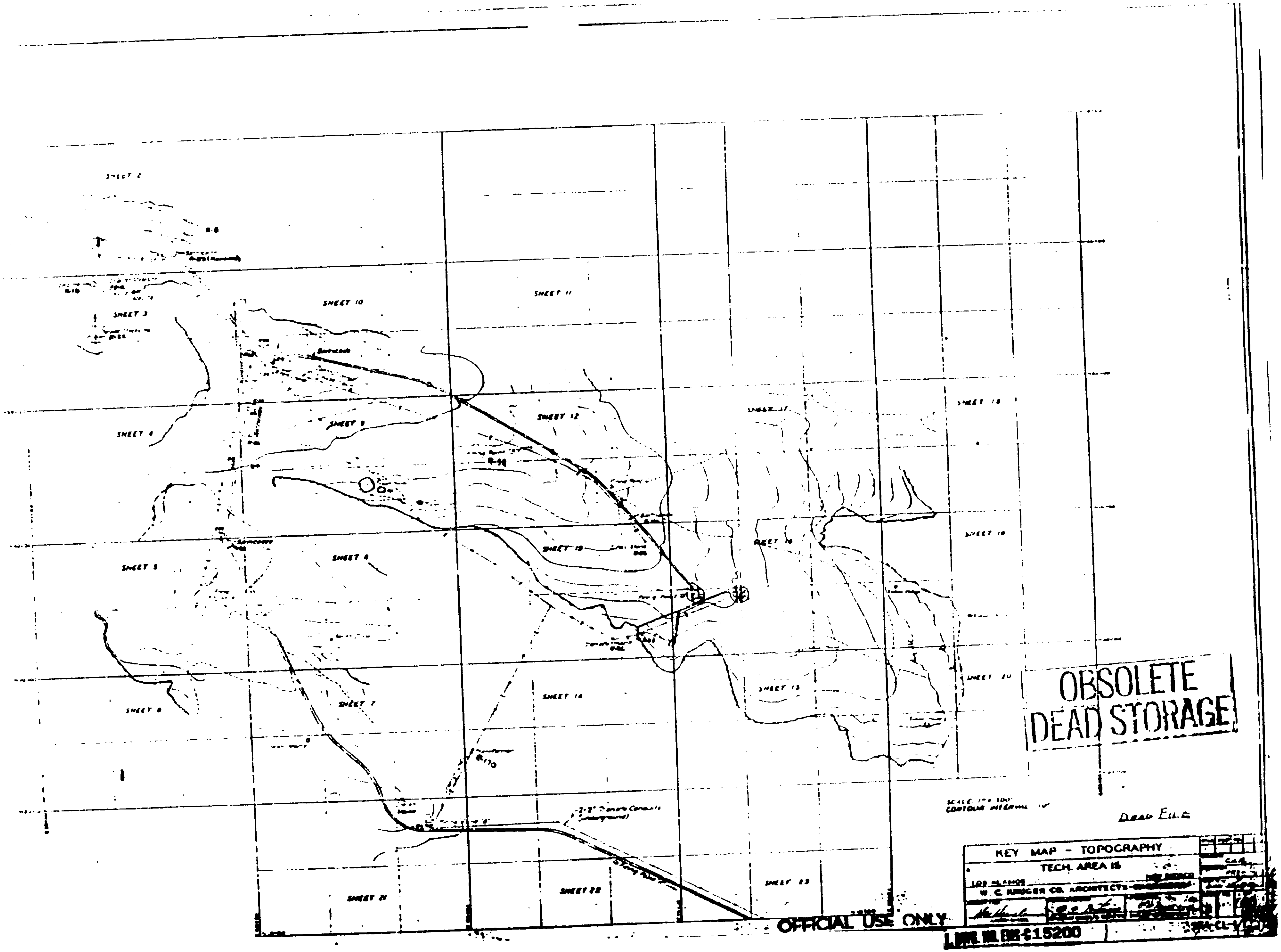


Figure D-8 TA-15 Topography Map (ENG-C 15200)

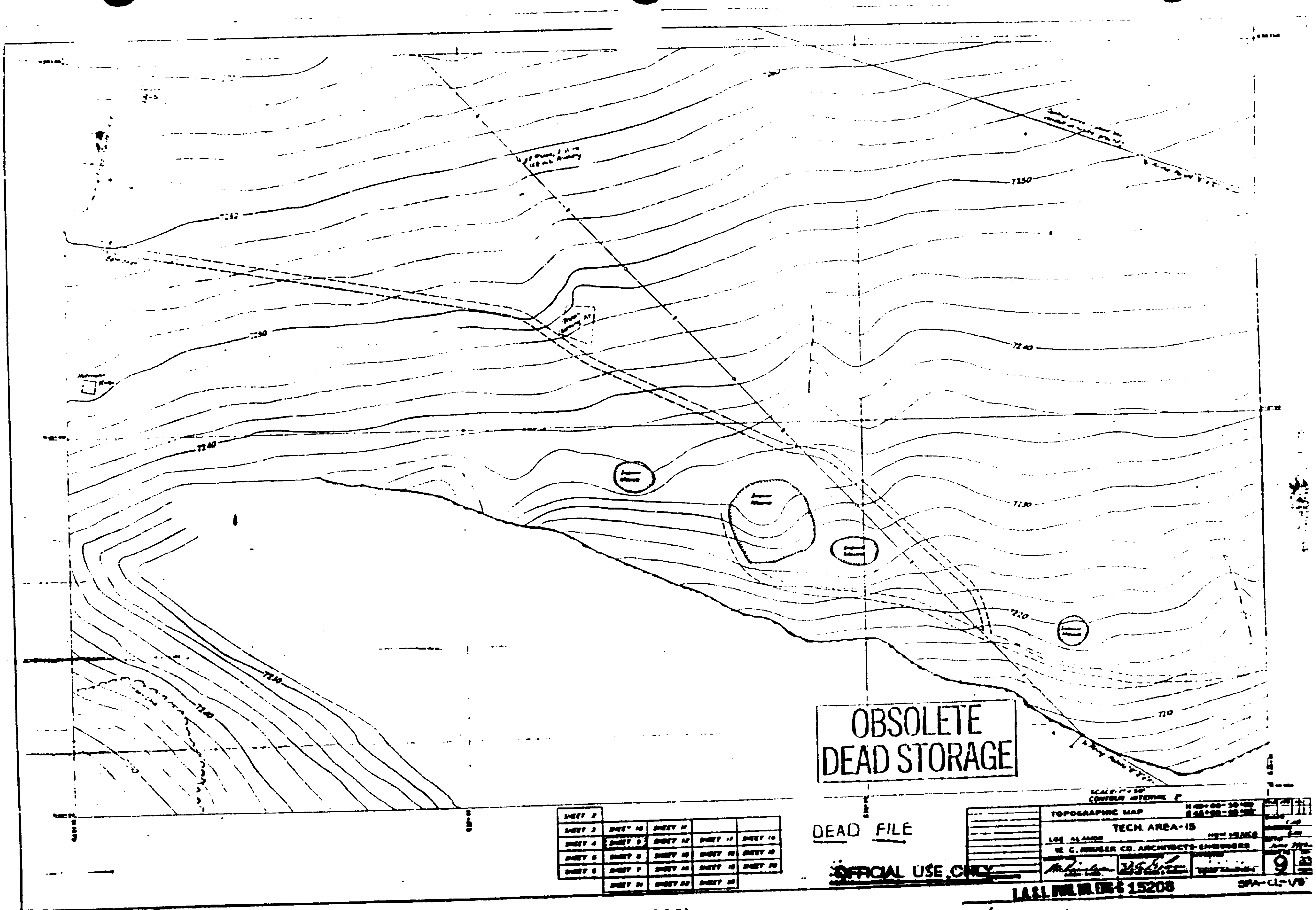


Figure D-9 TA-15 Topography Map (ENG-C 15208)

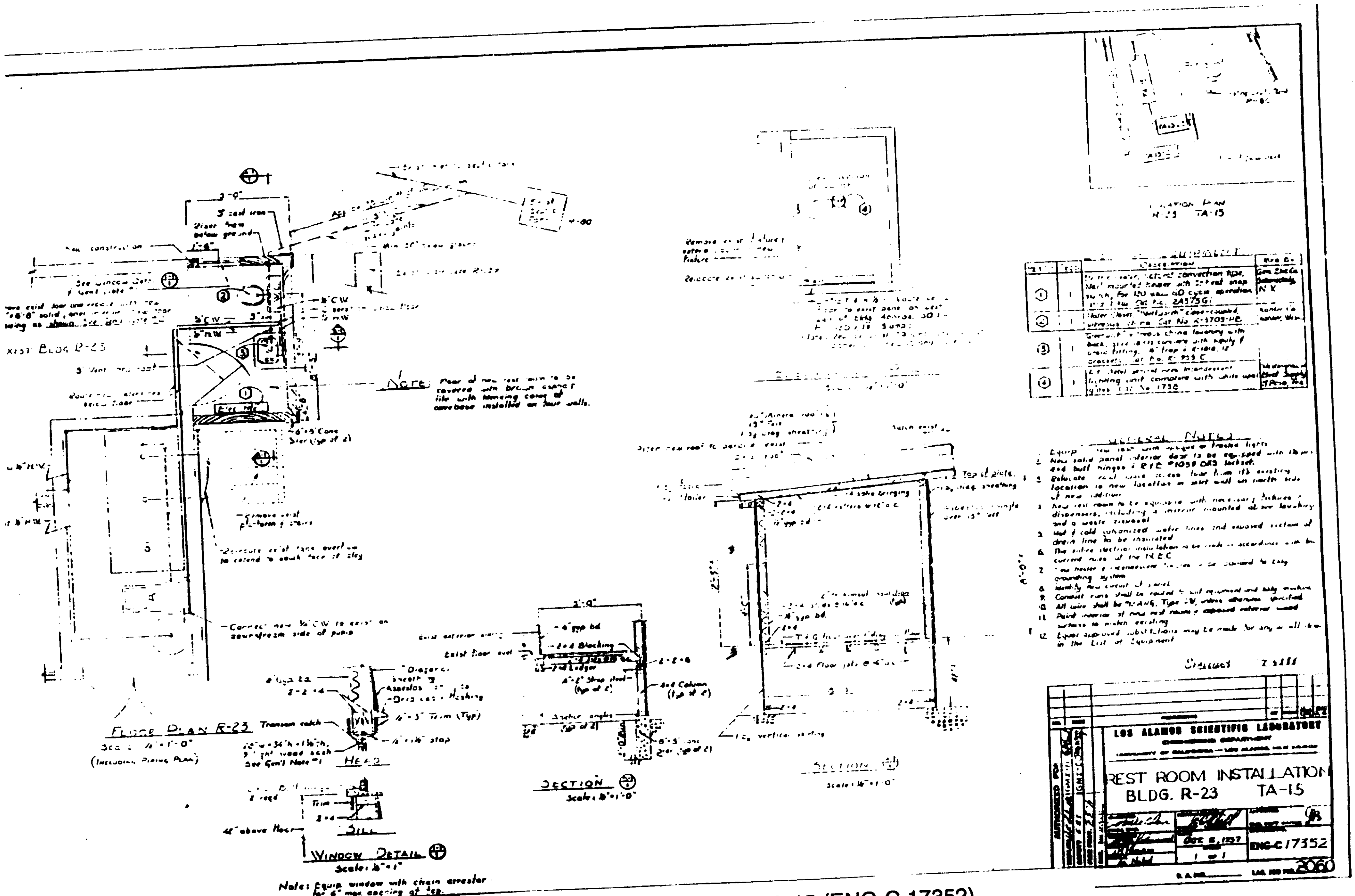


Figure D-10 Rest Room Installation, Bldg R-23, TA-15 (ENG-C 17352)

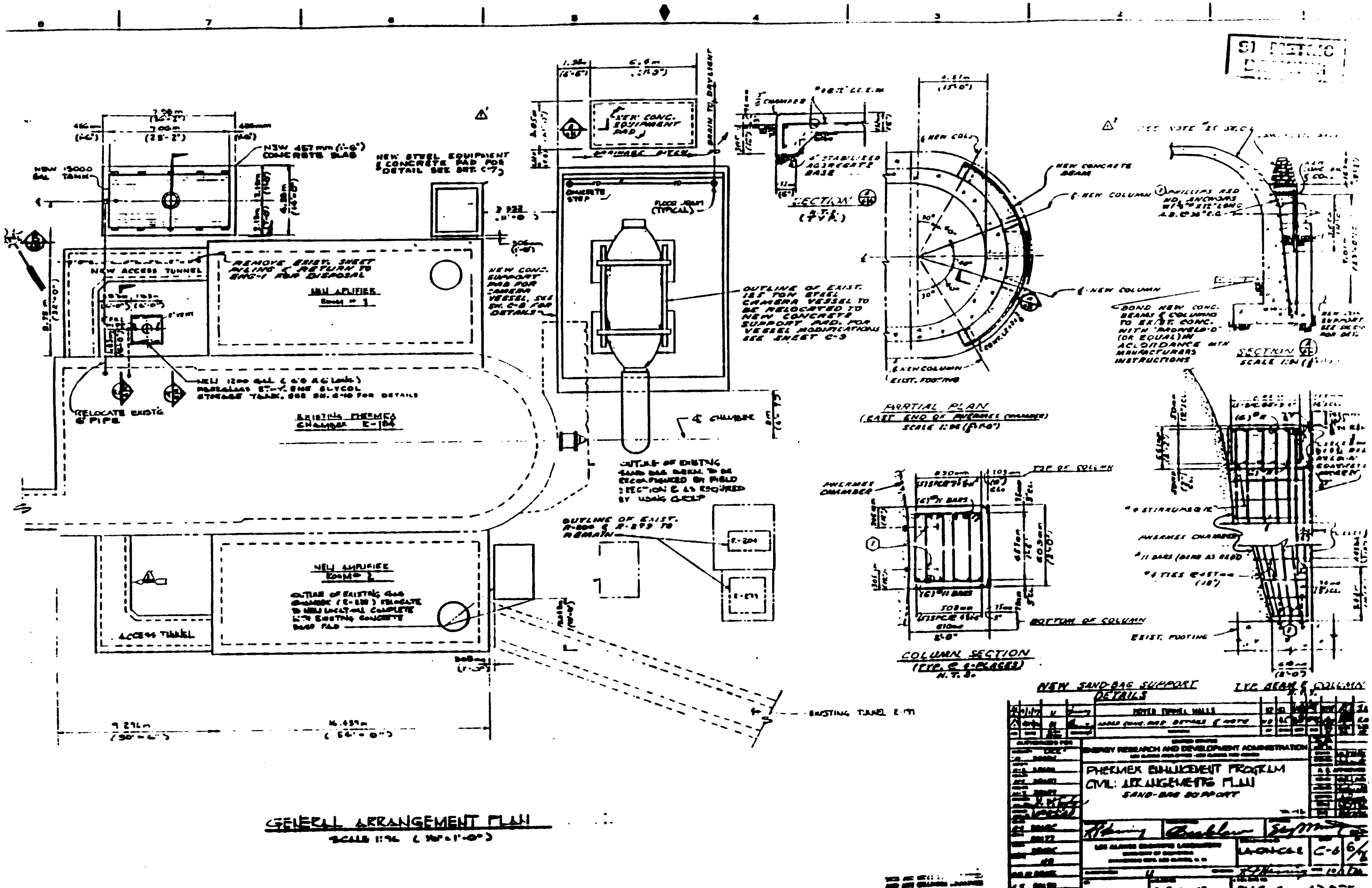


Figure D-11 PHERMEX Enhancement Program (ENG-C 43075)

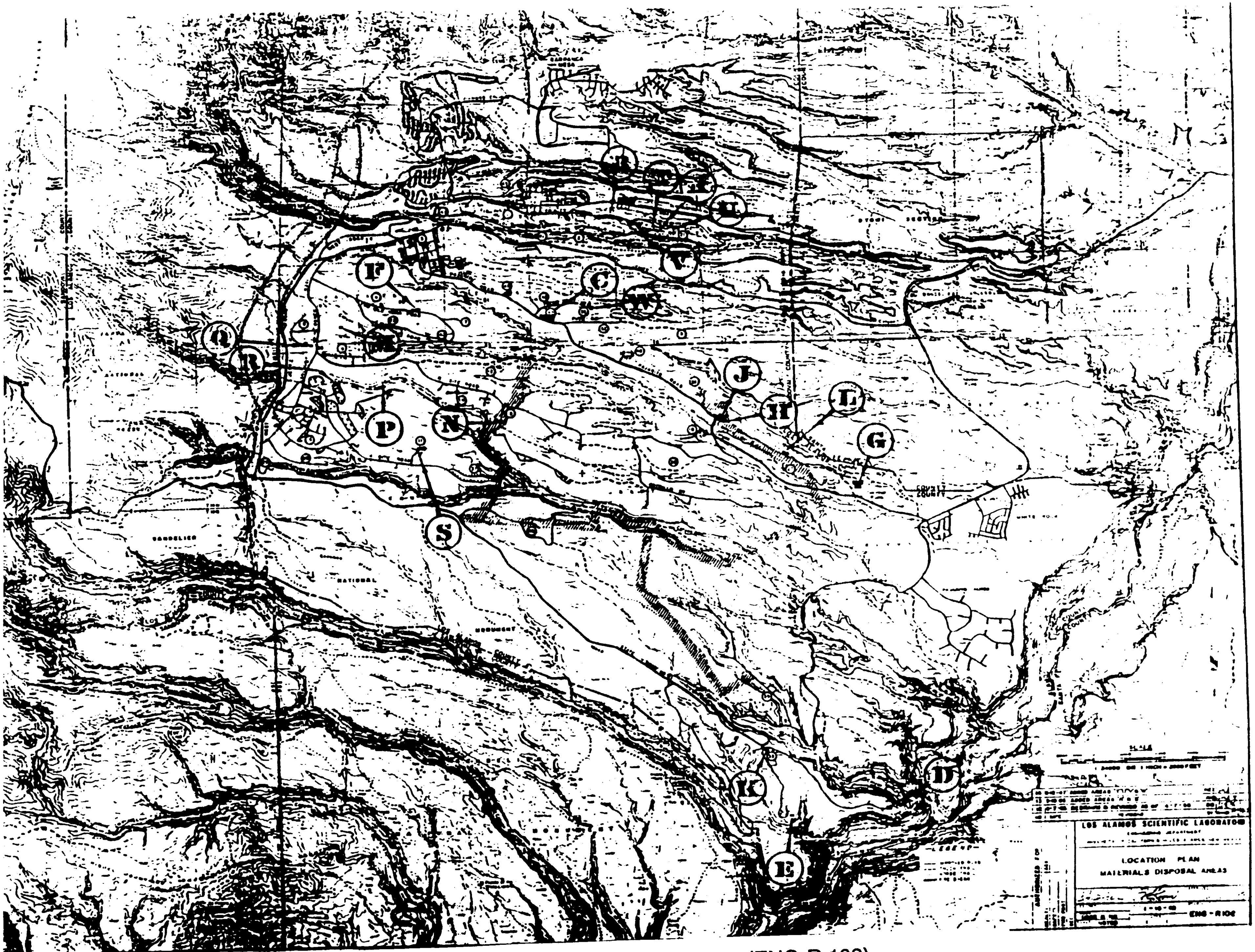


Figure D-12 Location Plan, Materials Disposal Area (ENG-R 102)

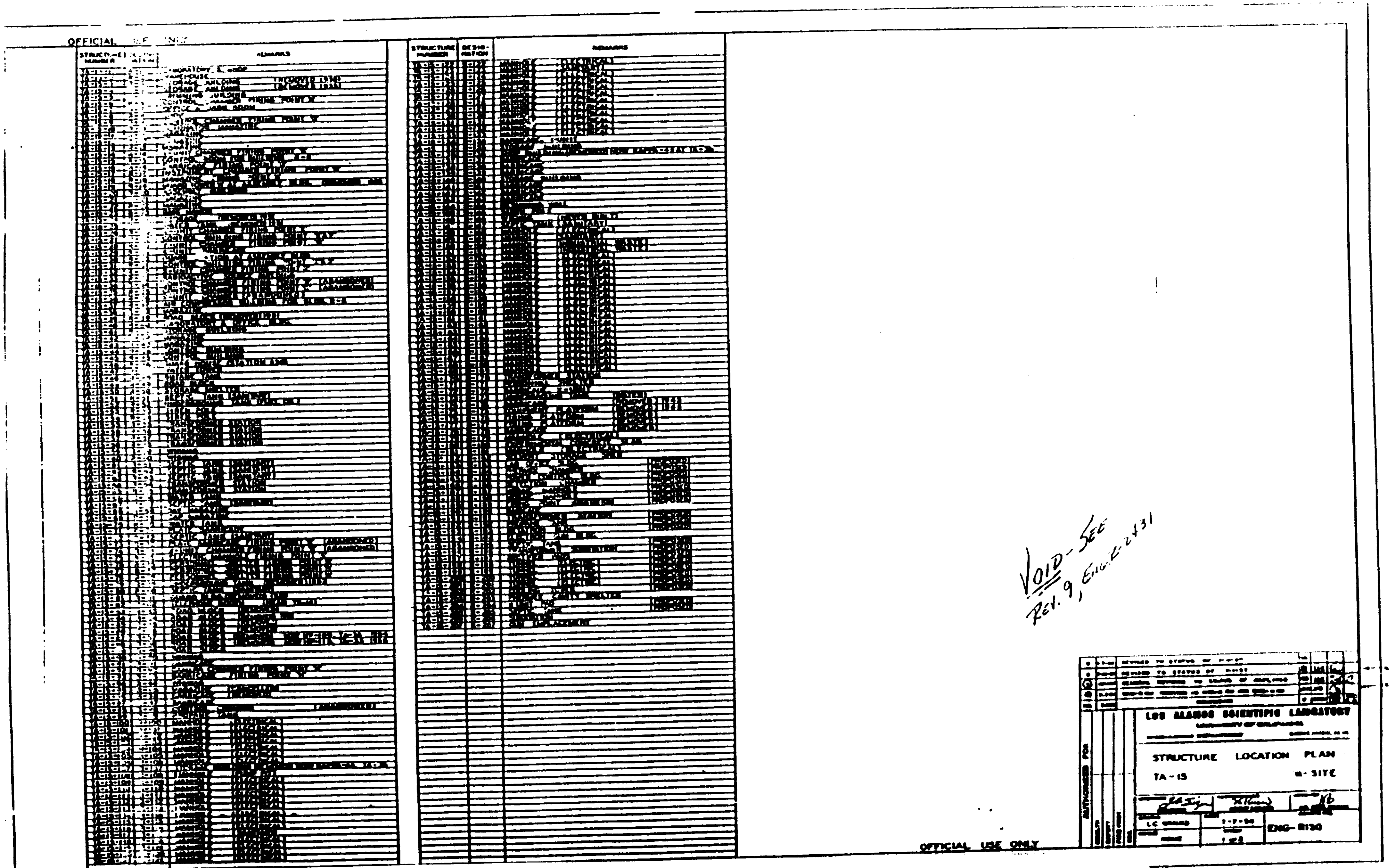


Figure D-13 Structure Location Plan, R Site, TA-15 (ENG-R 130)

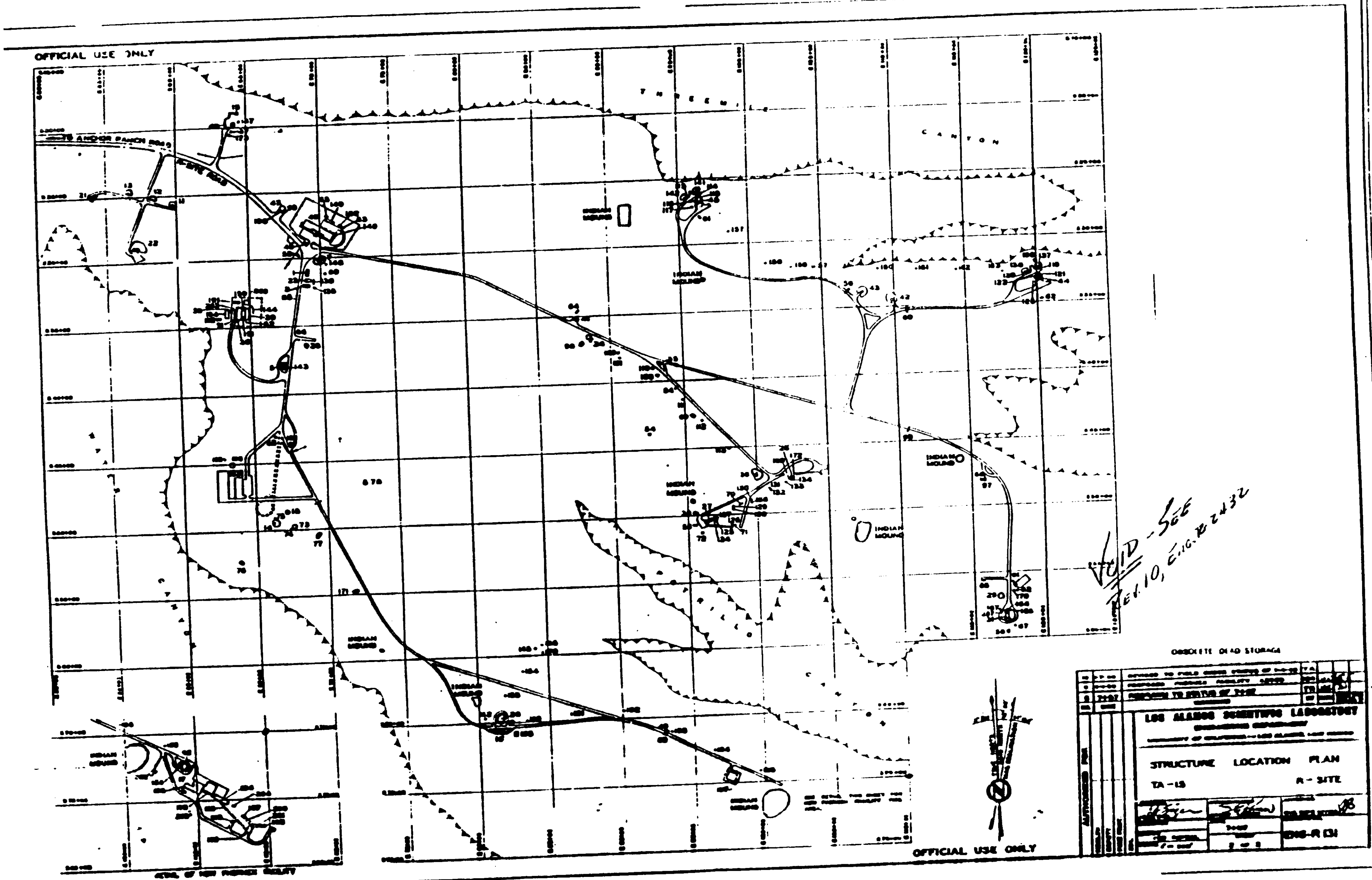


Figure D-14 Structure Location Plan, R Site, TA-15 (ENG-R 131)

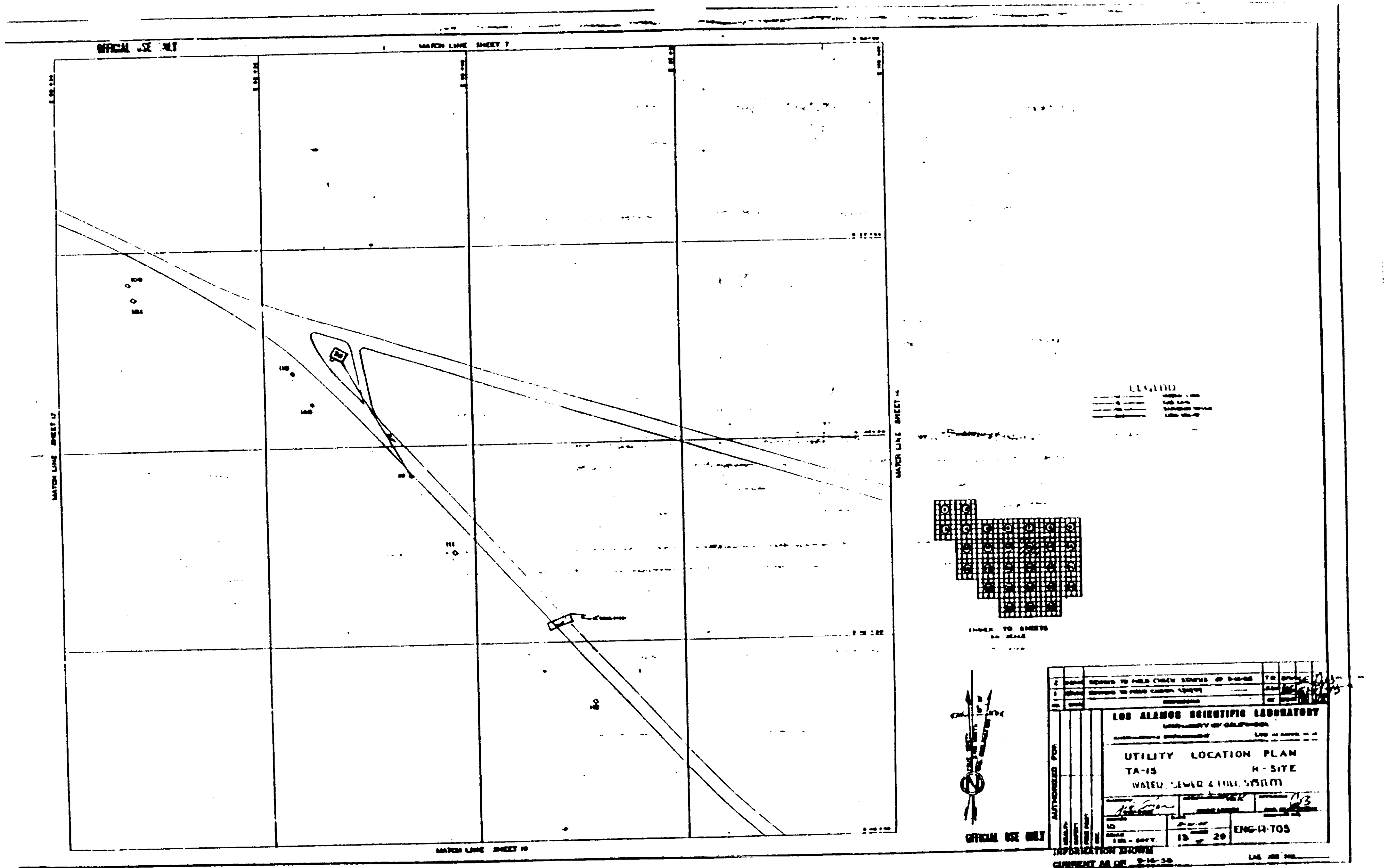


Figure D-15 Utility Location Plan, R Site, TA-15 (ENG-R 703)

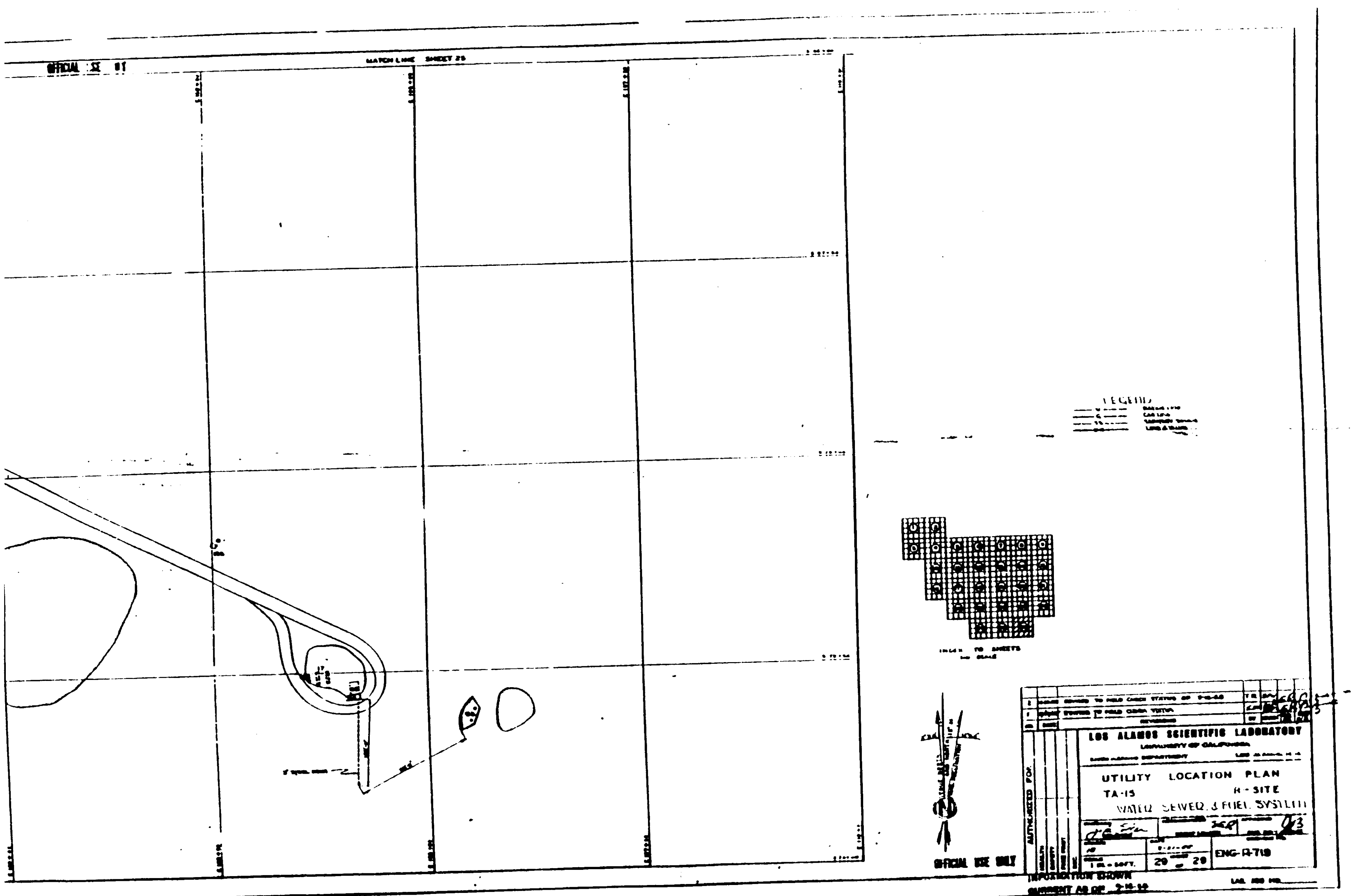


Figure D-16 Utility Location Plan, R Site, TA-15 (ENG-R 719)

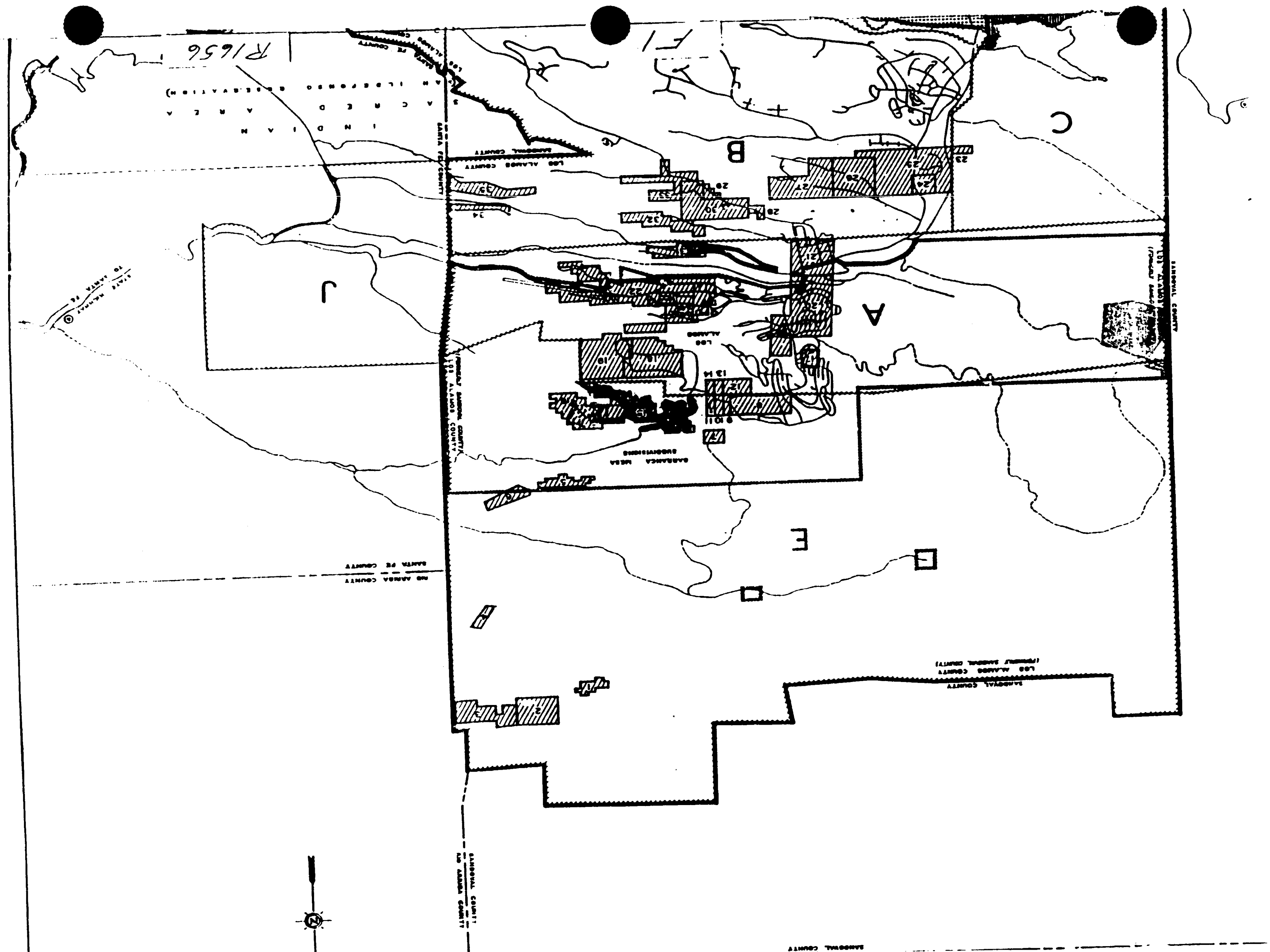


Figure D-17 Real Estate Transactions At Los Alamos (ENG-R 1656)

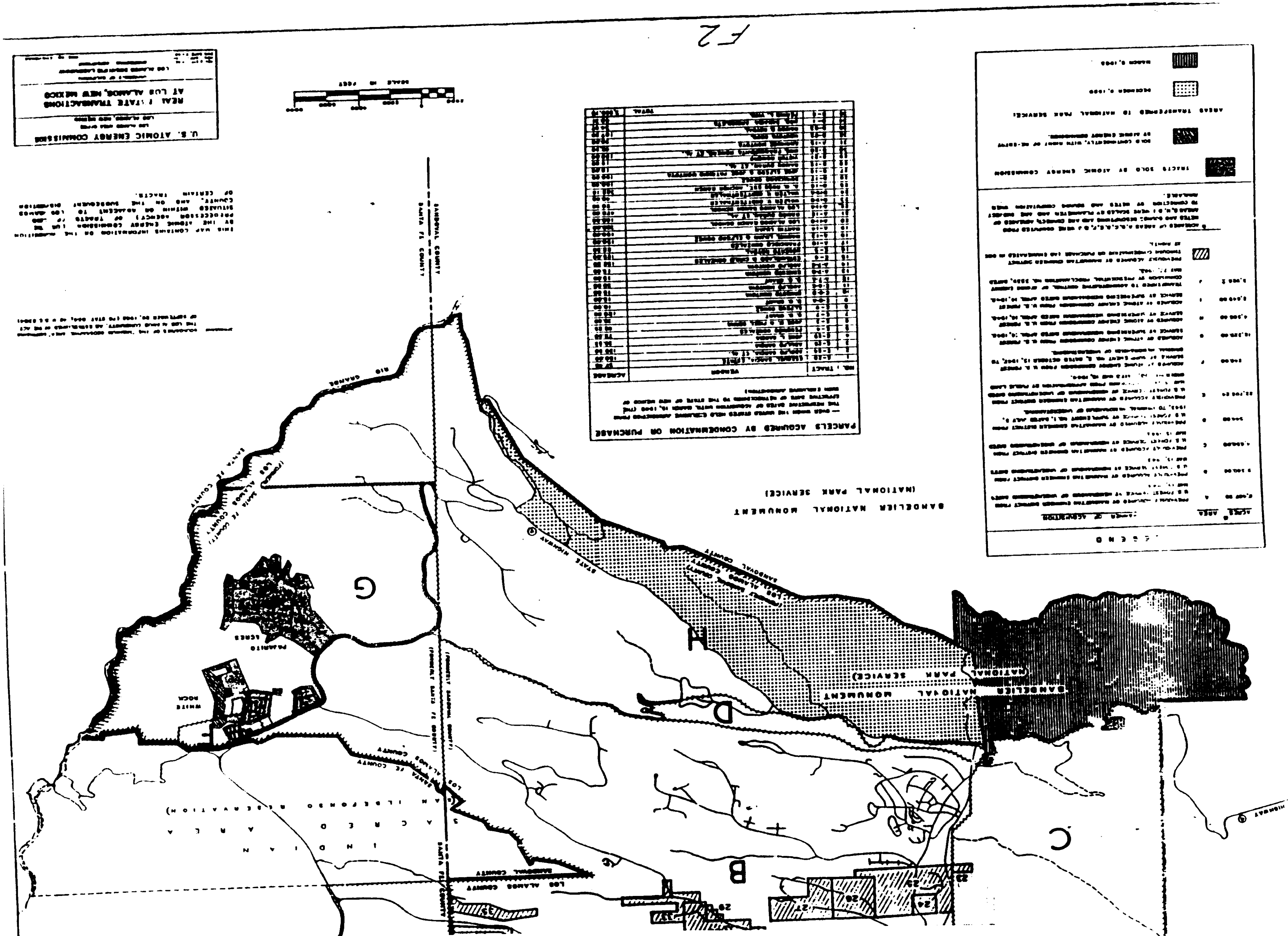


Figure D-18 Real Estate Transactions At Los Alamos (ENG-R 1656)

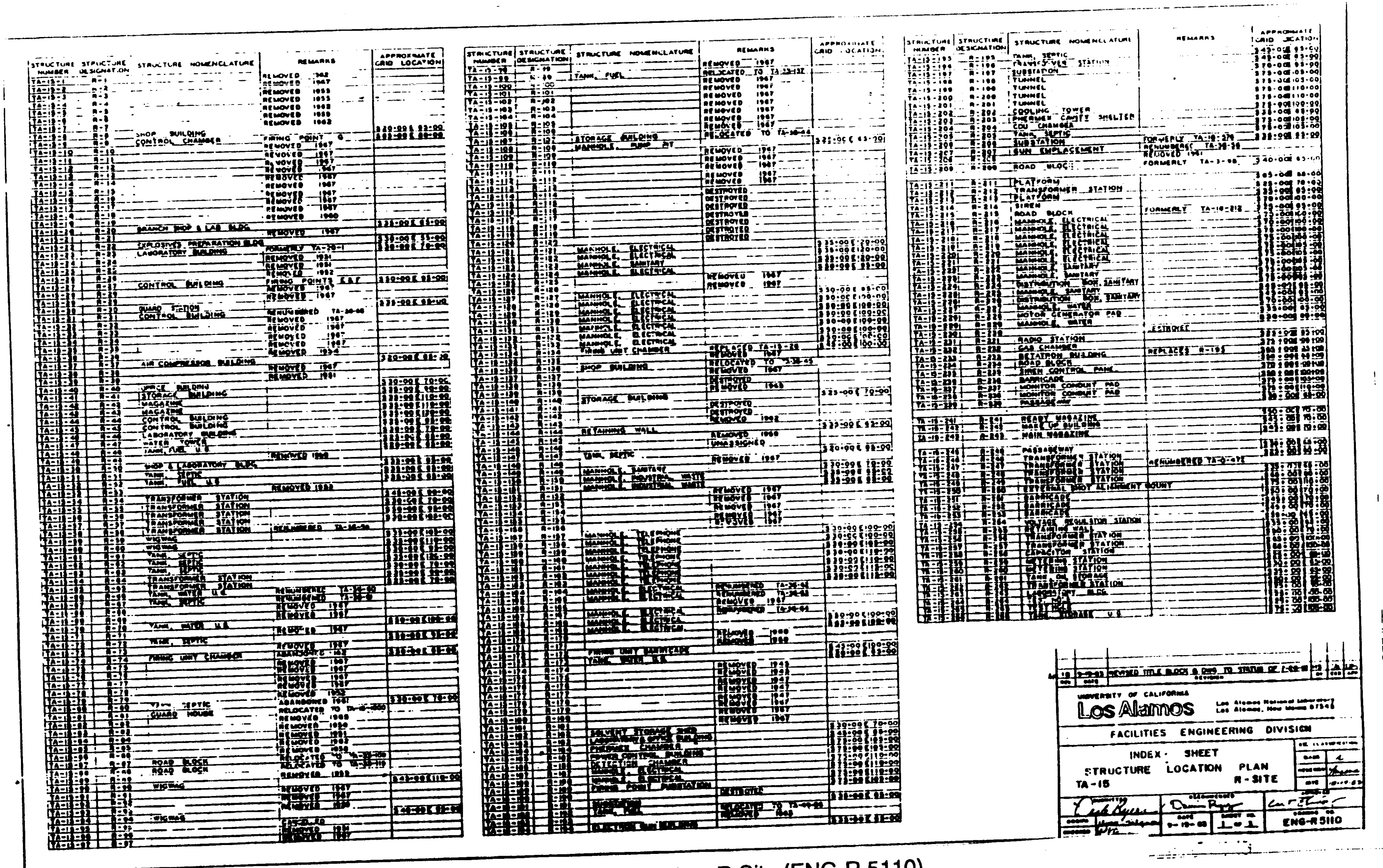


Figure D19 Index Sheet, Structure Location Plan, R Site (ENG-R 5110)

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	APPROXIMATE GRID LOCATION
267	R-267	MANHOLE, ELECTRICAL		S30:00 E120:00
268	R-268	TRANSFORMER STATION	NOT SHOWN	
269	R-269		CANCELLED	
270	R-270	TEST HOLE		S23:00 E100:00
271	R-271	TEST HOLE		[illegible]
272	R-272	TEST HOLE		[illegible]
273	R-273	TEST HOLE		[illegible]
274	R-274	TANK		[illegible]
275	R-275	CONTAINMENT VESSEL	"JUMBO"	[illegible]
276	R-276	FIRING POINT CHAMBER		[illegible]
277	R-277	TRANSFORMER STATION		[illegible]
278	R-278	TRANSFORMER STATION		[illegible]
279	R-279	CABLE TERMINAL BOX AND CONDUIT RUNS		S40:90 E105:00
280	R-280	CONTROL BLDG	NOT SHOWN	
281	R-281	BARRICADE		S45:00 E105:00
282	R-282	TANK, SEPTIC	CANCELLED	
283	R-283	TANK, SEPTIC		[illegible]
284	R-284	COMPARTMENT & TEL. FAC.		[illegible]
285	R-285	TANK, SEPTIC		[illegible]
286	R-286	TANK, STORAGE U.G.		[illegible]
287	R-287	"JUMBO" CONC. PAD		S72:00 E110:00
288	R-288	CAMERA BUNKER		S72:00 E110:00
289	R-289	SIGNAL CHAMBER		S78:90 E110:00
290	R-290	TANK, FUEL 10,000 GAL.		S78:90 E108:00
291	R-291	TRANSFORMER STATION	NOT SHOWN	
292	R-292		CANCELLED	
293	R-293			S40:99 E105:00
294	R-294	PUMP SHED	NOT SHOWN	
295	R-295	BATT		S40:90 E108:00
296	R-296	TRANSFORMER STATION		S40:90 E90:00
297	R-297	TRAILER, SHOP	FORMERLY TA-0-307	S70:00 E108:00
298	R-298	TRAILER, STORAGE	FORMERLY TA-0-[illegible]	S75:90 E108:00
299	R-299	TRAILER, STORAGE	FORMERLY TA-0-643	S75:90 E108:00
300	R-300	TRAILER, LABORATORY	FORMERLY TA-0-644	
308	R-308	TRANSPORTABLE OFFICE BLDG	FORMERLY TA-0-1200	S30:00 E70:00

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	APPROXIMATE GRID LOCATION

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	APPROXIMATE GRID LOCATION

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UNIVERSITY OF CALIFORNIA
Los Alamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

FACILITIES ENGINEERING DIVISION

INDEX SHEET
STRUCTURE LOCATION PLAN
TA-15 R-SITE

SHEET 1 of 1
ENG-R 5110

TO VAULT

Figure D-20 Index Sheet, Structure Location Plan, R Site (ENG-R 5110)

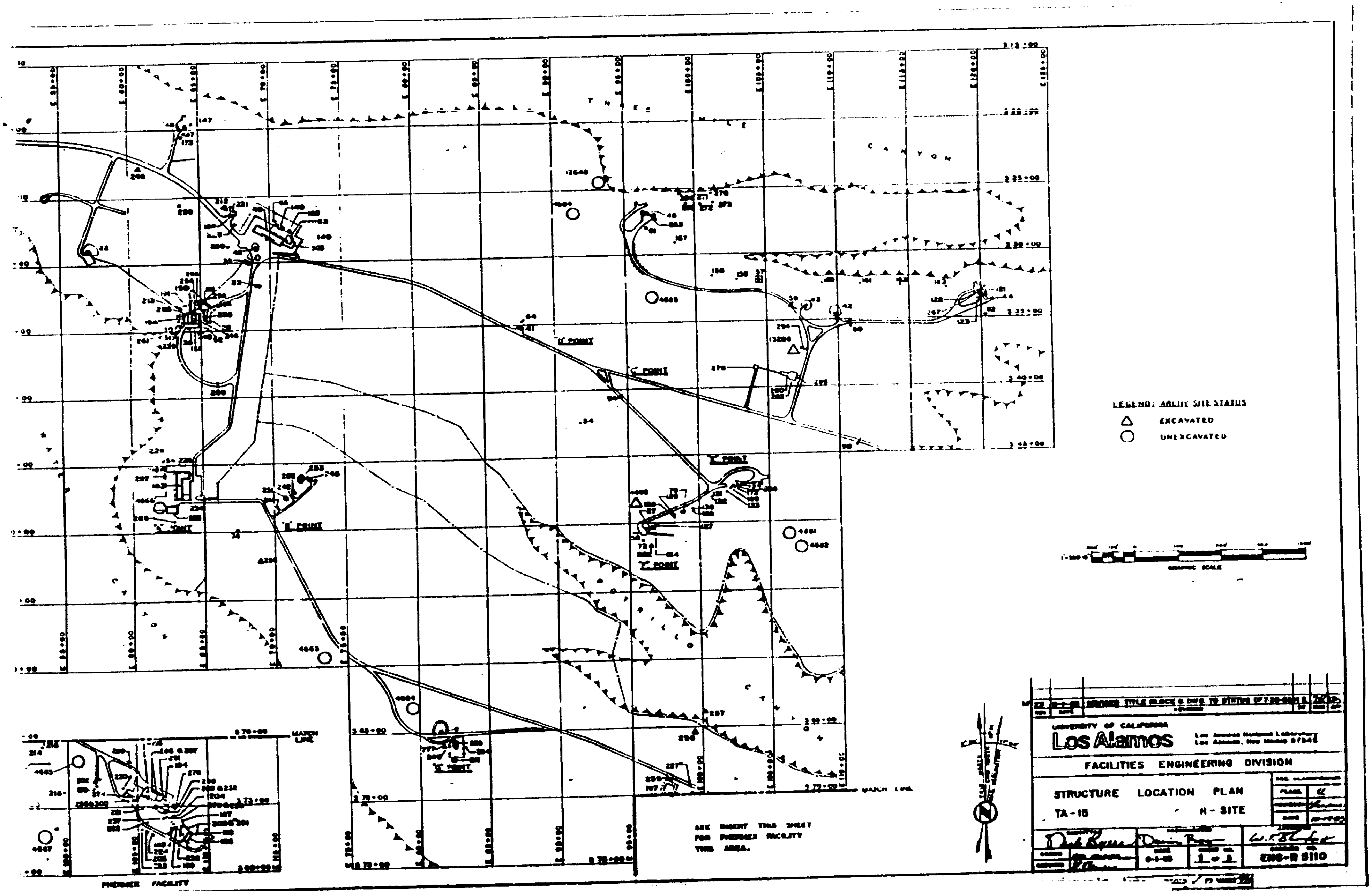

Figure D-21 Structure Location Plan, R Site, TA-15 (ENG-R 5110)

APPENDIX E

National Environmental Policy Act and Related Documents

APPENDIX E

NATIONAL ENVIRONMENTAL POLICY ACT AND RELATED DOCUMENTS

The NEPA evaluation and document preparation for TA-15 is an ongoing process. Updates to this section will be made as documents become available.

The status of TA-15 NEPA work as of June 15, 1993 is as follows:

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

E.1 Biological Resource Summary

E.1.1 Introduction and Further Information

During 1992, field surveys were conducted by the Biological Resource Evaluations Team (BRET) of the Environmental Protection Group (EM-8) for Operable Unit (OU) 1086, Technical Area (TA)-15 Site Characterization. Further information concerning the biological field surveys for this OU is contained in the full report "Biological and Flood Plain/Wet Land Assessment for Environmental Restoration Program, OU 1086." The biological assessment contains specific information on survey methods, results, and mitigation measures. This assessment will also contain information that may aid us to define ecological pathways and vegetation restoration.

E.1.2 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.

E.1.3 Methods

The surveys had three purposes: (1) to determine the presence or absence of any critical habitat for any state or federal sensitive, threatened, or endangered plant or animal species within the operable unit boundaries, (2) to identify the presence or absence of any sensitive areas such as floodplains or wetlands that may be present within the areas to be sampled and, if such an area is present, its extent and general characteristics, and (3) to provide additional plant and wildlife data concerning the habitat types within Operable Unit 1086. These data provide further baseline information about the biological components of the site that will enable site characterization and determination of presampling conditions. This information also is necessary to support the National Environmental Policy Act (NEPA) documentation and determination of a Categorical Exclusion of the sampling plan for site characterization.

This RFI work plan proposes to collect sediment samples and surface and subsurface samples. The sediment samples are to be taken from existing sediment basins within canyons located in the permeable unit. Soil samples may be collected from the subsurface where appropriate.

After searching the data base maintained in EM-8 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, researchers at the Laboratory conducted a Level II habitat evaluation survey. A Level II survey is performed when areas are present that are not highly disturbed and could potentially support threatened or endangered species. Techniques used in a Level II survey are 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 with the requirements for species of concern as identified in the data base search. If habitat requirements were not met, then no further surveys were conducted and the site was considered cleared for impact on state and federally listed species. If habitat requirements were met, species surveys were done in accordance with preestablished survey protocols, which often required certain meteorological or seasonal conditions.

In each location, the National Wetland Inventory Maps and field checks were used to note all wetlands and floodplains within the survey area. Criteria outlined in the Corps of Engineers Wetlands Delineation Manual (Federal Interagency Committee for Wetland Delineation 1989, 0631)) was used to note characteristics of wetlands, floodplains, and riparian areas.

E.1.4 Species Identified

Data base searches indicated that the species of potential concern for this operable unit are those listed in Table E.1-4.

E.1.5 Results and Mitigation

E.1.5.1 Threatened, Endangered, and Sensitive Species

Sensitive and endangered plant species may need to be surveyed further if specific sampling activities are proposed within any sensitive habitat. Each species has its own seasonal survey restrictions due to its flowering or emergence dates. BRET must be provided with specific sampling site locations. These data will help BRET to determine the necessity for surveying for a particular plant species. During the field season of 1992, each protected plant species was sought during the habitat evaluation surveys; none were found. However, the survey did not coincide with the blooming season of all the listed plants.

As a result of a habitat evaluation and previous data on the operable unit, several of the previously listed animal species may occur within or near the operable unit. These species are the Northern Goshawk, Jemez Mountains salamander (*Plethodon neomexicanus*), and the spotted bat (*Euderma maculatum*). These species are discussed in more detail below. The remaining animal species listed above are dismissed from further consideration because more specific suitable habitat components are lacking or because the species have not been located on habitat more suitable to them 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 found in ponderosa pine/Gambel oak (*Pinus ponderosa/Quercus Gambelii*), ponderosa pine/gray oak (*Quercus grisea*), and mixed conifer/Gambel oak habitat types. The mixed conifers include white fir (*Abies concolor*), Douglas-fir (*Pseudotsuga*

Table E.1.4 Species of Potential Concern

Common Name	Scientific Name	Federal Endangered	Federal Threatened	Federal Proposed	Federal Candidate	State Endangered
Bald eagle	*Haliaeetus lecocephalus*	X				X
Peregrine falcon	*Falco peregrinus*	X				X
Mexican spotted owl	*Strix occidentalis lucida*			X		
Northern goshawk	*Accipiter gentilis*				X	
Willow flycatcher	*Empidonax trailli extimus*				X	X
Spotted bat	*Euderma maculatum*				X	X
Jemez Mountains salamander	*Plethodon neomexicanus*				X	X
Broad-billed hummingbird	*Cynanthus latirostris*					X
Common black hawk	*Buteogallus anthracinus*					X
Misissippi kite	*Ictinia mississippiensis*					X
Grama grass cactus	*Toumeya papyracanthus*				X	X
Wood lily	*Lilium philadelphicum*					X
Wright's fishhook cactus	*Mammillaria wrightii*					X
Santa Fe cholla	*Opunita viridiflora*					X

Menziesii), and ponderosa pine (Kennedy 1987) All of the above habitat types are represented in the operable unit. Travis (1992, 0869) reports observations of possible breeding pairs in TA-15. The following measures shall be taken to avoid adverse impact to potential nesting Northern Goshawks:

1. Any machine sampling occurring between May and October shall be cleared through BRET. BRET shall be contacted 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 shall be contacted for a presampling site-specific survey.
3. Any tree removal (live or snag) shall be approved by BRET.

The Jemez Mountains salamander has been reported from upper Water Canyon (Ramotnik 1986). The animal requires rocks (talus slopes) or downed, well-decayed conifer trunks in mixed conifer forests. Moist slopes and moderate to heavy overstory cover also are necessary for this small amphibian's survival. Ramotnik recognized Cañon de Valle and Los Alamos, Pajarito, and Water canyons as a population center for this amphibian. This is one of three population centers that could serve as "refuges to protect [Jemez Mountains] salamanders from significant loss of habitat due to logging, fire or insect damage and maintain genetically viable populations." Impacts to salamanders would include habitat destruction due to tree removal, soil disturbance and removal of downed trees and limbs. The following mitigation measures are required if sampling is conducted within Potrillo, Three-Mile, or Water canyons.

1. BRET shall be notified 60 days prior to sampling to permit the team to evaluate the sampling site for the Jemez Mountains salamander. If a survey is required, it can be conducted only in the summer months after several days of heavy rains.
2. If sampling occurs on north-facing slopes or near streamside, a biologist from EM-8 shall be present during sampling. (This is not anticipated during phase I sampling). If any salamanders are discovered, all ground-disturbing activities will cease until the situation is evaluated.
3. Any trees that are cut will be left to enhance habitat.
4. All disturbed areas will be replanted with native plants.

The spotted bat is found in piñon/juniper, ponderosa pine, mixed conifer, and riparian habitats. The two critical requirements for the spotted bat are a source of water and an availability of roost sites (caves in cliffs or rock crevices). Water, Three-Mile and Potrillo canyons should have a sufficient number of potential roost sites, but water sources are limited. Suitable water is defined as small ponds or pools of slow-moving water. To date, no spotted bats have been successfully mist-netted on Laboratory property. Due to the nature and extent of the proposed site characterization in the canyon bottoms, no potential impacts to spotted bats will occur if small caves are not disturbed and if water sources in the canyon bottoms are not altered.

Several sensitive raptors breed in OU 1086 (Travis 1992, 0869). Travis reports substantiated observations of breeding pairs of American Kestrel (*Falco sparverius*), Great Horned Owl (*Bubo virginianus*), and Red-tailed Hawk (*Buteo jamaicensis*). Zone-tailed Hawk (*Buteo albonotatus*) and Turkey Vulture (*Cathartes aura*) may breed in TA-15. Potential raptor nest sites occur in ponderosa pine and mixed conifer forest; steep cliffs with small caves and rock crevices, found in the operable unit, also provide the seclusion and commanding views required for nesting. From May to September, nesting sites should be free of any major disturbances such as the use of heavy equipment. However, major disturbances occur routinely at this OU's firing sites. The same notification procedures will be used as are used in the routine operations on the site. BRET shall be consulted to identify potential nesting sites prior to any machine sampling or use of other heavy equipment.

E.1.5.2 Wetlands/Floodplains

Portions of the stream channel in Upper Water (Canon de Valle) and Three-Mile Canyon are classified by the National Wetlands Inventory as possible palustrine wetlands. Survey data suggest some of these areas have characteristics of jurisdictional wetlands. In addition, there are six NPDES permitted outfalls in which four of these have some hydrophytic vegetation associated with them and may also qualify as jurisdictional wetlands. None of these wetlands exceed ten acres and most are less than one acre. Floodplain maps developed by McLin (1992, 0825) indicate that a floodplain does exist within Water, Three-Mile and Potrillo Canyons. 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 1086 as long as best management practices outlined in Section E.1.6 are adhered to.

E.1.6 Best Management Practices

Impacts to nonsensitive plants should be avoided when possible. Off-road driving is especially harmful to plants and soil crust. Revegetation may be required at some sites. A list of native plants suitable for revegetation for OU 1086 is contained in the final report "Biological Assessment for the Environmental Restoration Program, OU 1086". Some additional best management practices include the following:

- Avoid unnecessary disturbance (i.e., parking areas, equipment storage areas, off-road travel) to surrounding vegetation during the actual sampling and when traveling into sampling sites.
- Avoid removal of vegetation along water sources, drainage systems, and stream channels.
- Avoid disturbance to vegetation along canyon slopes, especially in drainage areas.
- Avoid tree removal. If tree removal is required, BRET should be contacted for evaluation.

In addition to these measures, BRET also requests notification of any activity that would disturb the vegetation before that activity is actually conducted.

The "Biological Assessment for the Environmental Restoration Program, Operable Unit 1086" will be evaluated by the US Fish and Wildlife for compliance with the Endangered Species Act. This federal agency may require additional mitigation measures that are not represented in this summary.

E.2. 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 1992 at OU 1086. The methods and techniques that were used for this survey conformed to those specified in the "Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation" (Federal Register, Vol. 48, No. 190).

Eighty-six archaeological sites are located in the surveyed area at TA-15 (Hoagland et al. 1993, 10-0048). Eighty of these are eligible for inclusion on the National Register of Historic Places under Criterion D because of their potential to yield research data. These are listed in Table E.2-1.

The attributes of these sites that make them eligible for inclusion on the National Register will not be affected by any environmental restoration (ER) sampling activities proposed at OU 1086. 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.

All monitoring and avoidance recommendations contained in the final report shall be followed by all personnel involved in ER sampling activities. EM-8 archaeologists shall be contacted 30 days before any ground-breaking activities are initiated so that monitoring and avoidance recommendations can be verified. The same procedures will be applied to ER personnel that apply to the operating group, M-4.

Table E.2-1 Archaeological Sites Located at OU 1086

Site #	Site Type	Cultural Affiliation	Time Period	Eligible for National Registered Historic Places
LA 4665	XP	Anasazi	Coalition-Classic	Yes
LA 4666	SP	Anasazi	Coalition	Yes
LA 4682	PP	Anasazi	Coalition	Yes
LA 14869	RR	Anasazi	Coalition	Yes
L-39	SP	Anasazi	Coalition	Yes
L-40	SP	Anasazi	Coalition	Yes
L-41	FH	Anasazi	Coalition-Classic	Yes
L-46	SP	Anasazi	Coalition	Yes
Q-61	SP	Anasazi	Coalition	Yes
Q-62	AS	Anasazi	Coalition	PE
Q-63	AS	Archaic/ Anasazi	Archaic/ Coalition-Classic	PE
Q-64	FH	Anasazi	Coalition/ Classic	Yes
Q-65	AS	Archaic/ Anasazi	Unknown/ Classic	PE
Q-66	FH	Anasazi	Coalition-Classic	PE
Q-67	FH	Anasazi	Coalition	Yes
Q-68	SP	Anasazi	Classic	Yes
Q-69	SP	Anasazi	Coalition	Yes
Q-70	FH	Anasazi	Coalition	Yes
Q-71	FH	Anasazi	Coalition	Yes
Q-72a	FH	Anasazi	Classic	Yes
Q-72b	IR	Anasazi	Classic	Yes
Q-73	SP	Anasazi	Coalition-Classic	Yes
Q-74	IR	Anasazi	Coalition	PE
Q-75	FH	Anasazi	Coalition	Yes
Q-76	FH	Anasazi	Coalition	Yes
Q-77	FH	Anasazi	Classic	Yes
Q-78	SP	Anasazi	Coalition	PE
Q-79	AP	Anasazi	Coalition	PE
Q-80	WC	Anasazi	Classic	PE
Q-81	SP	Anasazi	Coalition	Yes
Q-82	SP	Anasazi	Coalition	Yes
Q-83	AS	Anasazi	Coalition	PE
Q-84	FH	Anasazi	Coalition	Yes
Q-85	AS	Archaic/ Anasazi	Unknown/ Classic	PE
Q-86	AP	Anasazi	Coalition	Yes
Q-87	SH,RA	Anasazi	Coalition	Yes
			Coalition/	

Table E.2-1

Site #	Site Type	Cultural Affiliation	Time Period	Eligible for National Registered Historic Places
Q-88	WC	Anasazi	Classic	No
Q-89	SP	Anasazi	Coalition	Yes
Q-90	AS	Anasazi	Coalition	PE
			Coalition	PE
Q-91	CP	Anasazi	Classic	
			Coalition	
Q-92	CP	Anasazi	Classic	Yes
Q-93	LS	Archaic	Unknown	PE
			Coalition-	
Q-94	CP	Anasazi	Classic	PE
Q-95	FH	Anasazi	Coalition	Yes
			Coalition-	
Q-96	CP	Anasazi	Classic	YesQ-97
	SP	Anasazi	Classic	Yes
			Coalition-	
Q-98	SP	Anasazi	Classic	Yes
Q-99	FH	Anasazi	Classic	Yes
			Coalition-	
Q-100	AP	Anasazi	Classic	PE
			Classic or	
Q-101	FH	Anasazi	General Historic	Yes
			Coalition-	
		Anasazi &/	Classic/	
Q-102	IR	or Unknown	General Historic	PE
			Coalition-	Yes
Q-103	FH	Anasazi	Classic	
		Anasazi/	Coalition-	
		Euro-	Classic/	
Q-104	WC	American	Homesteading	PE
Q-105	FH	Anasazi	Classic	Yes
			Coalition-	
		Anasazi/	Classic/	
Q-106	IR	Unknown	General Historic	PE
			Coalition-	
		Anasazi/	Classic/	
Q-107	IR	Unknown	General Historic	PE
Q-108	SP	Anasazi	Coalition	Yes
Q-109	FH	Anasazi	Coalition	Yes
Q-110a	FH	Anasazi	Coalition	Yes
Q-110b	FH	Anasazi	Coalition	Yes
Q-110c	FH	Anasazi	Coalition	Yes
Q-111	CP	Anasazi	Classic	Yes
Q-112	RA	Anasazi	Unknown	Yes
Q-113	SH	Anasazi	Classic	Yes
Q-114	CP	Anasazi	Classic	Yes
Q-137	FH	Anasazi	Coalition	Yes
Q-138	WC	Anasazi	Coalition	No
Q-139	FH	Anasazi	Coalition	Yes
			Coalition-	

Table E.2-1 (continued)

Site #	Site Type	Cultural Affiliation	Time Period	Eligible for National Registered Historic Places
Q-140	FH	Anasazi	Coalition-Classic	Yes
Q-141	FH	Anasazi	Coalition-Classic	Yes
Q-142	FH	Anasazi	Coalition-Classic	Yes
Q-102	IR	or Unknown	General Historic	PE
Q-143	WC	Euro-American	Manhattan Project to Recent	No
Q-144	RA	Anasazi	Unknown	Yes
Q-145	SH	Anasazi/	Coalition-Classic	Yes
Q-146	SH	Unknown	General Historic	Yes
Q-147	IR	Anasazi/ Unknown	Coalition-Historic	PE
Q-150	FH	Anasazi	Coalition-Classic	Yes
Q-151	FH	Anasazi	Coalition	Yes
Q-152	FH	Anasazi	Coalition-Classic	Yes
Q-153	IR	Anasazi	Coalition Classic	Yes
Q-155	FH	Anasazi	Coalition	Yes
Q-157	SP	Anasazi	Coalition-Classic	Yes
Q-158	SP	Anasazi	Coalition	Yes
Q-159	FH	Anasazi	Coalition	Yes
W-15	SP	Anasazi	Coalition-Classic	Yes
W-16	IR	Anasazi	Coalition/ Classic	Yes
W-19	SP	Anasazi	Coalition	Yes

Codes for Site Types: AP = Amorphous Pueblo, AS = Artifact Scatter, CP = Cavate(s) or Cavate Pueblo, FH = Fieldhouse, IR = Indeterminate Rubble, LS = Lithic Scatter, PP = Enclosed Plaza Pueblo, RA = Rock Art/Petroglyph, RR = Rock Ring, SH = Rock Shelter, SP = Single Roomblock Pueblo, WC = Water or Soil Control Deviced, and XP = Complex Shpaed Pueblo.

Eligibility Code: PE = Potentially Eligible

Time Period Dates: Archaic Period = 4,000 B.C. to A.D. 600, Coalition Period = A.D. 1100 to A.D. 1325, Classic Period = A.D. 1325 to A.D. 1600, General Historic Period (which includes the Spanish Colonial and Territorial Period and the Homesteading Period) = A.D. 1600 to A.D. 1943, Homesteading Period = A.D. 1890 to A.D. 1943, Manhattan Proejct to Recent Period = A.D. 1942 to

APPENDIX E REFERENCES

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APPENDIX F

Occupational Exposure at PHERMEX, TA-15 Risk Assessment

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FIGURES

TABLES

1.0 Introduction

The PHERMEX facility at Technical Area- (TA) 15, Los Alamos National Laboratory (LANL), is actively engaged in explosive tests involving many different materials including depleted uranium (DU). Testing has been conducted at PHERMEX for about the past 30 yr. During the explosions, DU is fragmented into a whole range of sizes with the debris being scattered about the test area. The larger pieces are collected and disposed of by appropriate means following a test. A small percentage of the DU is aerosolized and deposited on the grounds around PHERMEX. In addition to DU, nonradiological hazardous materials have also been involved, including beryllium, lead, and mercury. All deposited materials are, to some extent, mobile owing to the action of wind resuspension processes. After years of testing, measurable levels of DU surface contamination and other materials are present in the soils in, and around, the test-firing area at PHERMEX.

Where surface contamination is present, the action of wind resuspension of soil can introduce small DU particulates into the air; the DU now being partially in the form of hydrated oxides sometimes attached to soil particles where surface contamination is present. Smaller particulates can be inhaled by workers and will create a potential internal exposure pathway. In addition, radionuclide particulate matter on the ground, whether resuspendable or not, can create a background intensity of gamma radiation known as ground-shine. These exposure pathways can result in potentially significant exposure to PHERMEX workers if the surface contamination is large enough.

The conservative analysis presented here estimates the levels of surface contamination that are acceptable to the health and safety of workers. Using regulatory levels of allowable exposure to workers, acceptable levels of surface contamination are estimated for contaminants of concern. Several means for calculating the effects of wind resuspension are used in the study, including resuspension factor, resuspension rate, and mass loading methods. Multiple practices are used to provide a cross check between methods.

The analysis in this study is based on a broad hypothetical assumption that the ambient concentration level of surface contamination has a maximum value of 1g/m^2 in the test-firing area. This assumption is made for all contaminants of concern including DU. This study also assumes that the nature of resuspendable particulates containing uranium and other test materials is essentially constant after each test irrespective of the time duration since deposition. That is to say, freshly deposited material acts no differently than older material and that there are no ultra-fine particulates that resuspend in a different manner with the first wind after the test. Using the hypothetical surface contamination, exposure levels are calculated for the maximally exposed worker where work is performed. Calculated exposure levels are compared to acceptable exposure levels from which an acceptable surface-contamination level is computed. Lastly, the acceptable levels of surface contamination are compared to actual contamination levels at PHERMEX.

Exposures for three different work areas are considered. The first two are at PHERMEX: Buildings R-310 and the firing point [SWMU 15-006 (a)] and the third area is at the complex known as 183, as shown in Figure 1-1 which includes several buildings.

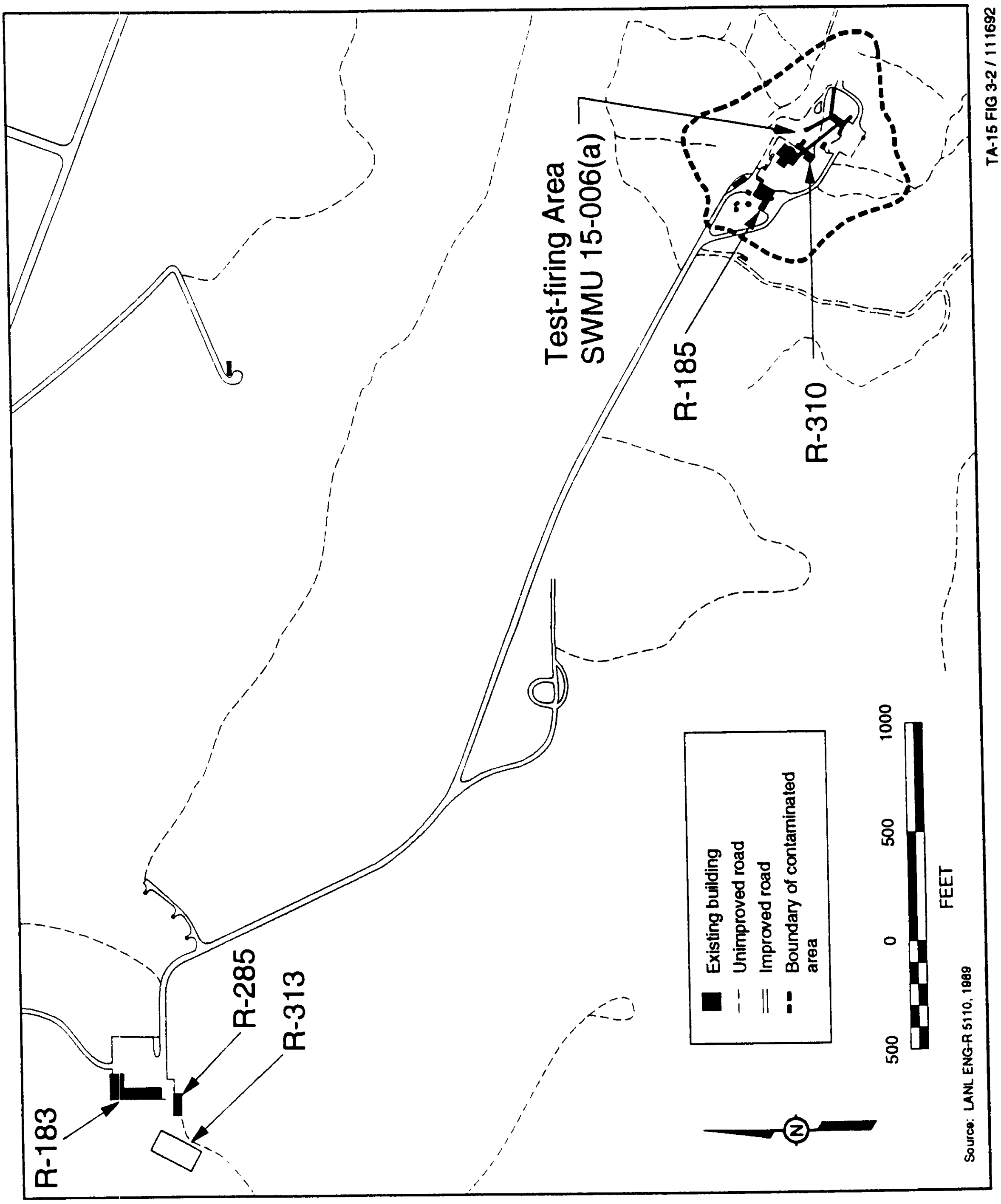


Figure 1-1 TA-15 site plan.

This risk assessment deals primairly with radiological contamination and not chemical toxicity of associated with metals such as uranium, beryllium, lead and mercury.

2.0 Limits On Occupational Workers

This chapter describes the existing limits and regulating agencies that restrict occupational exposure. Table II-1 summarizes the maximum current occupational contaminant exposure.

Table II-1 Occupational Exposure Limit

Contaminant	Limit	Regulation
Radionuclides	2.0 rem/yr EDE	DOE[a], 1992
Radionuclides	5.0 rem/yr EDE	DOE, 1989
Radionuclides	50.0 rem/yr other organs	DOE, 1989
Be	0.002 mg/m^3	ACGIH[b], 1988
Pb	0.015 mg/m^3	ACGIH, 1988
Hg	0.01-0.10 mg/m^3	ACGIH, 1988
	0.001 mg/m^3	DOE[C], 1991

[a] U.S. Department of Energy

[b] American Conference of Governmental Industrial Hygienists

c DOE 1991-office of Health Physics and Industrial Hygiene

For radionuclides, the annual exposure limit is 5.0 rem effective dose equivalent (EDE) from all pathways. However, personnel may not receive this exposure without the prior written consent of DOE. Therefore, a lower exposure limit of 2.0 rem/yr represents the effective maximum exposure limit. The dose limits are a composite of exposures to all radionuclides. The EDE is an organ weighted dose that takes into account internal exposure to various critical parts of the body. In addition to the EDE standard, the annual exposure limit to a critical organ is 50.0 rem.

Nonradiological exposure is based on a 40 hr/wk air concentration provided by the Threshold Limit Value (TLV) for Occupational Exposure (ACGIH 1988). Beryllium (Be) exhibits the lowest limit or standard at 0.002 mg/m^3. The standard for exposure to lead (Pb) is 0.015 mg/m^3. Mercury (Hg) has a range of standards because rates of exposure depend on its chemical form. The most restrictive forms of Hg have an exposure limit of 0.001 mg/m^3 (when in a finely dispersed form).

3.0 Surface Contamination at TA-15

This chapter discusses the current levels of potentially dispersible surface contaminants at the PHERMEX facility. These include levels of DU, Be, Pb, and Hg.

3.1 Radiological Contamination

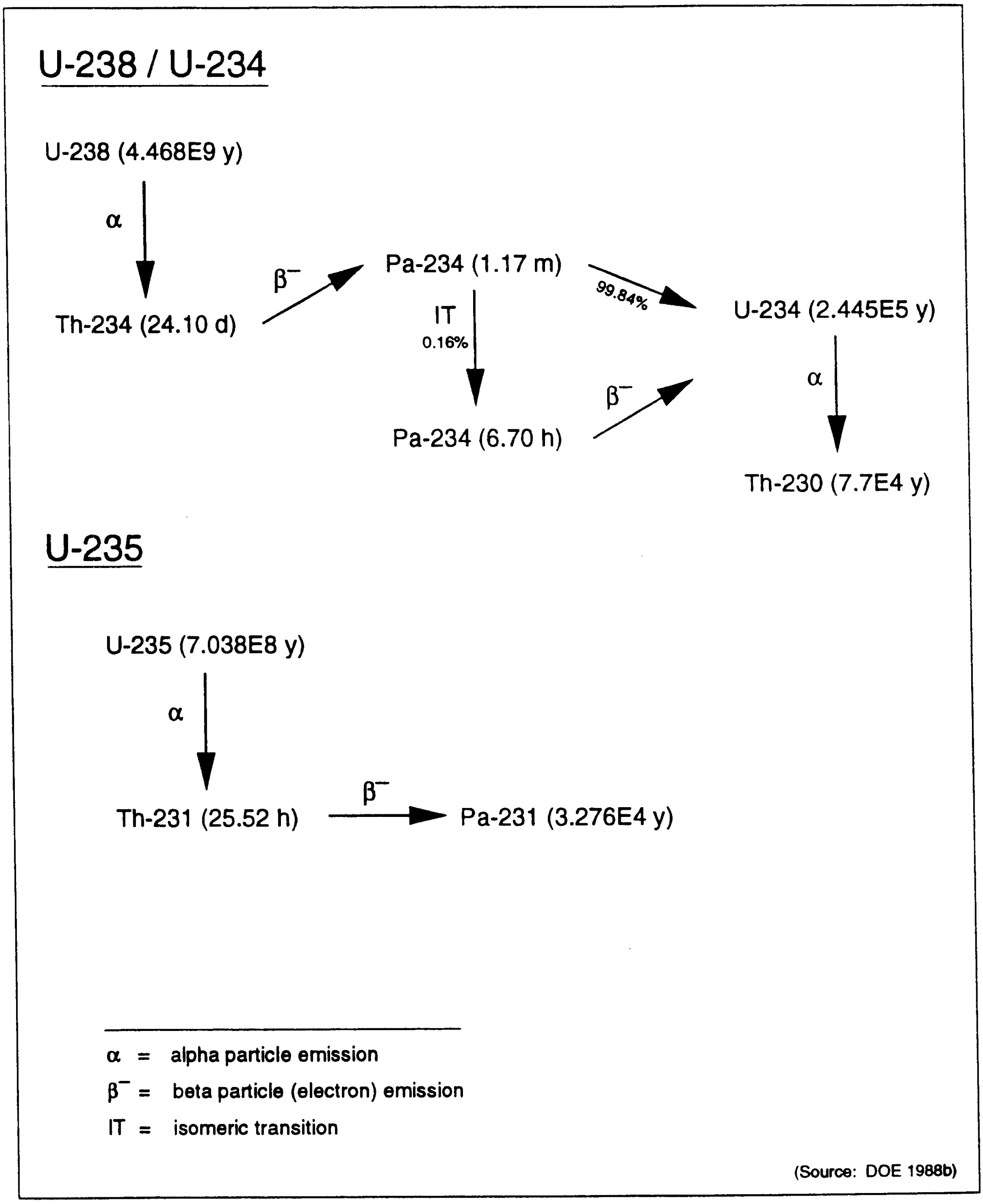
The increased potential for radiological exposure at PHERMEX is due to the presence of DU in the near-surface soils around PHERMEX. DU is a mixture of several isotopes including uranium (U), thorium (Th), and other daughter products. Table III-1 summarizes the principal isotopic components of typical Rocky Flats-grade DU. All the uranium isotopes in DU are alpha-emitting and are largely responsible for any potentially significant radiological exposure. Figure 3-1 illustrates the decay chain for DU and the formation of daughter products.

Table III-1 Isotopic Composition of Rocky Flats 10-yr-old DU[a]

Nuclide	Element	Activity (Ci/g Mix)
Pa-234	protactinium	3.4×10^{-7}
Pa-234m	protactinium	3.4×10^{-7}
Th-231	thorium	4.9×10^{-9}
Th-234	thorium	3.4×10^{-7}
U-234	uranium	3.7×10^{-8}
U-235	uranium	4.9×10^{-9}
U-238	uranium	3.4×10^{-7}

[a] Rockwell 1985 (decayed 10 yr)

An aerial survey of PHERMEX was conducted in 1982 (Appendix G) to estimate the extent and degree of radionuclide contamination of the areas in, and around, PHERMEX. The survey monitored area levels of protactinium (Pa)-234m, a granddaughter of U-238. From the aerial survey, the surface contamination was seen to decrease radially as the distance from the test-firing area increased (see Figure 1-1). A total of 58 600 m^2 around PHERMEX was estimated to be contaminated above background. The contaminated area can be represented by a circular area that has a radius of 137 m with the center at building R-310, immediately southwest of the test-firing area, at the point closest to the firing area. Surface soil sampling in the test-firing area of PHERMEX shows DU concentration at average values of about 400 µg/g of small dispersible particulates (EM-8, unpublished results) Much of the DU involved in testing at PHERMEX is properly collected and disposed of following a test. If it is defined that only 1% of the DU released is dispersible, and that the



TA-15, FIG 3-1 / 111092

Figure 3-1 Partial decay scheme for DU.

material is absorbed into an effective surface depth of 200 µm (Nuclear Regulatory Commission [NRC] 1983), and the soils possess a density of 1.5 g/cc, a value of 1400 µg/g is estimated over the 6000 m^2 test-firing area, (the radius of 137m).

3.2 Nonradiological Contamination

The soil-sampling results also show an average surface contamination of Be of about 32 µg/g (EM-8 unpublished results). Table III-2 summarizes the levels of dispersible nonradiological surface contaminants at PHERMEX. No data is available for lead and mercury.

Table III-2 Dispersible Surface Contamination at TA-15[a]

	Soil Sampling		Calculated (µg/g)	
Material	(µg/g)	(g/m2)	Firing Area	All Areas
DU	400	0.12[a]	1420	170
Be	32	0.0096[a]	---	---

[a] Assumes 200 µm surface depth and 1.5 g/cc soil density (NRC, 1983)

4.0 Wind Resuspension of Soil

The wind pickup and suspension of a contaminant in the soil surface is a phenomenon known as wind resuspension. Wind resuspension occurs as a result of mechanical stresses caused by man's activities and by simple wind-induced resuspension of any dusty surfaces.

Soil particulates are continuously suspended, deposited, and resuspended by the action of the wind. The result is an airborne concentration of a soil contaminant, which can induce exposure to people at locations within, and downwind of, sites possessing surface contamination. Wind resuspension is greatly enhanced when the contaminated soil surface is mechanically disturbed. Disturbances such as vehicular or pedestrian traffic have been shown to substantially increase the air concentrations of resuspended particulates.

In this analysis, three methods are used to calculate the air concentrations from wind resuspension of surface contaminants at TA-15.

4.1 Resuspension Factor

The resuspension factor is a quantity that, when multiplied by the level of surface contamination, yields an airborne concentration of a given contaminant. This conceptual formulation of the effects of wind resuspension is used in calculating the exposure to an individual who is located in the immediate vicinity; that is, personnel who work within the contaminated surface area. Such an exposure scenario occurs at TA-15 to personnel who work in the test-fire area. (See Chapter 6 of this appendix for a description of the exposure scenario.)

The airborne concentration of a given contaminant using a resuspension factor formulation is expressed mathematically as

$$C = K * S \qquad (1)$$

where

C = the concentration of the contaminant in the air above a contaminated surface (g/m^3),

K = the resuspension factor (1/m), and

S = the level of surface contamination (g/m^2).

While the calculation of air concentration is mathematically simple, the resuspension factor, K, is a function of many parameters including wind speed, contamination depth, mechanical stresses, deposit age, soil properties such as type and humidity, contaminant properties such as density and oxidation rate of relatively large fragments of DU, and so on.

Table IV-1 lists several empirically derived values for the resuspension factor for plutonium (Pu) and uranium. The resuspension factor clearly varies over several orders of magnitude depending on the specific experimental constraints imposed by each test scenario.

The age of the deposition of the surface contamination and the physical characteristics of the surface are major factors in developing a characteristic resuspension factor. Dispersible surface contamination undergoes transport away from the initial site of deposition. Linsley (Linsley 1978) recommends a resuspension factor of 10^{-5} 1/m if there is regular disturbance by pedestrian or vehicular traffic and a decreasing function of time thereafter:

$$K = 10^{-5} * e^{(-.677 * t)} + 1 \times 10^{-9} \qquad (2)$$

where,

K = resuspension factor (1/m), and

t = time following the surface deposition (yr).

The resuspension factor of Eq. 2 is most representative of unvegetated, desert soils and, therefore, applicable to soils in the Los Alamos area. Linsley (Linsley 1978) also found that if the surface is well vegetated the resuspension factor drops by about an order of magnitude.

For the 10 most recent years of tests, a composite air concentration is calculated using Equation 2. For the first year in which t = 0.5 yr (midpoint in

Table IV-1 Empirically Determined Resuspension Factors

Location	Source Material	Resuspension Stress	Resuspension Factor (1/m)	Reference
Nevada Test Site soil	Pu	Extensive vehicular traffic	7×10^{-5}	Langham, 1971
Contaminated field soil	Pu	Downwind of tractor	5×10^{-8} to 1×10^{-6}	Milham et al, 1976
Contaminated field soil	Pu	Pedestrian dust	1×10^{-6} to 3×10^{-4}	Stewart, 1967
Contaminated field soil	U	Dust stirred	1×10^{-3}	Stewart, 1967
Small unventilated room	Alpha contamination	People walking	3×10^{-4} to 2×10^{-2}	Mitchel and Eutsler, 1967
Room, concrete floor	Pu facility	No circulation	1×10^{-5} to 2×10^{-4}	Glauberman et al., 1967
Room, concrete floor	Pu facility	Fan-air stress	3×10^{-4} to 3×10^{-3}	Glauberman et al., 1967
Room, concrete floor	Pu facility	Fan and dolly movement	4×10^{-3} to 1×10^{-2}	Glauberman et al., 1967
Room, concrete floor	U facility	No circulation	7×10^{-5} to 4×10^{-4}	DOE, 1984
Room, concrete floor	U facility	Fan-air stress	3×10^{-5} to 2×10^{-4}	DOE, 1984
Room, concrete floor	U facility	Fan and dolly movement	2×10^{-4} to 1×10^{-3}	DOE, 1984

year in which t = 1.5 yr, a resuspension factor of 3.6 x 10^{-6} 1/m is calculated. Table IV-2 summarizes the results of the calculation for the past 10 yr. Table IV-2 also shows the relative contribution to the current air concentration from material deposited from successive past years. Contributions to air concentrations are additive from previous years.

Table IV-2 Base-Case Resuspension Factor[a]

Past Year	Resuspension Factor (1/m)[b]	Average Air Concentration (g/m^3)[c]	Percent Contribution
1	7.1 x 10^{-6}	7.1 x 10^{-6}	49.5
2	3.6 x 10^{-6}	3.6 x 10^{-6}	25.0
3	1.8 x 10^{-6}	1.8 x 10^{-6}	12.5
4	9.4 x 10^{-7}	9.4 x 10^{-7}	6.5
5	4.8 x 10^{-7}	4.8 x 10^{-7}	3.3
6	2.4 x 10^{-7}	2.4 x 10^{-7}	1.7
7	1.2 x 10^{-7}	1.2 x 10^{-7}	0.8
8	6.3 x 10^{-8}	6.3 x 10^{-8}	0.4
9	3.3 x 10^{-8}	3.3 x 10^{-8}	0.2
10	1.7 x 10^{-8}	1.7 x 10^{-8}	0.1
Total		1.4 x 10^{-5}	100

[a] Based on deposition of 1 $g/m^2/yr$ surface contamination

[b] Eq. 2

[c] Eq. 1

Not surprisingly, Table IV-2 shows that the most significant air concentrations are from the most recent years of deposits. In fact, tests from 7-10 yr ago have contributed only 1.5% to the air concentration. What material remains from those tests is no longer available for wind resuspension. The aerial survey described in Section 3.1 of this appendix, consequently, has no quantitative impact on current air concentrations. However, the circular configuration of surface contamination with a maximum near the test-firing area is still assumed to be an accurate representation of the distribution of the more recently deposited material. Other studies suggest that over 95% of the DU is still onsite and has not been dispersed.

From Table IV-2, an air concentration of 1.4 x 10^{-5} g/m^3 will be used in the exposure assessment when exposure occurs within the source area. This value is based on a unit surface contamination of 1 g/m^2, which is deposited per year for the past several years. This value is most applicable to unvegetated soils. If the source area is vegetated and undisturbed, the air concentration is reduced by a factor of 10 to 1.4 x 10^{-6} g/m^3.

4.2 Mass Loading

To check on the air concentration calculated using the resuspension factor, another approach employing the concept of mass loading is used. As with the resuspension factor, mass loading is appropriate for calculating air concentrations in the vicinity of the source area.

Air monitoring around LANL has determined that the annual average air concentration of small respirable particulate matter (PM) to be about 7 $\times 10^{-6}$ g/m^3 (7 μg/m^3) and a maximum PM level of about 1.0 x 10^{-4} g/m^3 (100 μg/m^3). LANL's 1989 surveillance report (LANL, 1989) shows a maximum measured mass loading value of 88 μg/m^3. Those values represent the mass loading in a local undisturbed setting. An air concentration of contaminant material is calculated by assuming that the particulate matter in the air originates from the contaminated soil in the test-fire area.

The air concentration using a mass loading formulation is expressed mathematically as

$$C = M * FR \qquad (3)$$

where,

C = the air concentration above a contaminated surface (g/m^3),

M = the mass loading air concentration (g/m^3), and

FR = the fraction of surface soil that is contaminated (dimensionless).

In the base-case scenario, it is assumed that a surface contamination, S, of 1 g/m^2 is present. This value is converted to the volumetric surface contamination as

$$FR = \frac{S}{L * D} \qquad (4)$$

where,

S = the surface contamination (g/m^2),

L = the effective surface depth (m), and

D = the soil density (g/m^3).

The effective surface depth from which the area concentration originates is recommended as 200 μm (NRC, 1983). Using a soil density of 1.5 x 106 g/m^3 (1.5 g/cc), the base-case scenario has a fraction, FR, of 0.0033 or 3300 μg/g contaminated soil. Using the maximum mass-loading air concentration of 1.0 x 10^{-4} g/m^3, a base-case air concentration of 3.3 x 10^{-7} g/m^3 is calculated using the mass-loading approach.

This result represents the mass loading in an area that does not receive enhanced or regular surface disturbances or stresses. An increase by a factor of 10 is conservatively assumed to occur as discussed in Section 4.1 of this appendix when regular disturbances are expected. Routinely disturbed areas at PHERMEX will, therefore, be assumed to have air concentrations of 3.3 x 10^{-6} g/m^3 in the base-case scenario.

4.3 Resuspension Rate

Resuspension rate is another way to mathematically characterize the contaminant's wind resuspension. The resuspension rate is multiplied by the surface contamination to yield a given contaminant's rate of release from the surface. This conceptual formulation of the effects of wind resuspension is particularly useful in calculating the exposure to an individual who is located downwind of an area possessing surface contamination. The resuspension rate is used to calculate an area source rate which can then be placed in an air dispersion model for estimating downwind effects. Such an exposure scenario is relevant for TA-15 personnel who work at the PHERMEX R-185 complex located some distance away from the test-firing area. (See Chapter 6 of this appendix for a description of the exposure scenario.) The reduction in contaminant air concentration from air dispersion during transport to the downwind receptor location yields a significantly lower exposure level.

The release rate of a given contaminant using a resuspension rate formulation is expressed mathematically as

$$R = F * A * S \qquad (5)$$

where,

R =the release rate of a contaminant from a contaminated surface (g/s),

F = the resuspension rate (1/s),

A = the area's contamination (m^2), and

S = the level of surface contamination (g/m^2).

While the calculation of the release rate is mathematically simple, the resuspension rate is a function of many parameters similar to those listed for the resuspension factor. In particular, the resuspension rate is a function of the wind speed over the contaminated area. Figure 4-1 illustrates the strong relationship of resuspension rate to wind speed over several orders of magnitude as the wind ranges from 1 m/s to about 20 m/s. The values presented in Figure 4-1 are for respirable soil particles with diameters less than ~7 µm.

The downwind location of occupational exposure at TA-15 building R-313 is toward the west-northwest (WNW) direction. Using the stability array meteorological data (STAR) for Los Alamos and Fig. 4-1, an annual-averaged resuspension rate can be calculated for the WNW wind sector. The STAR data provides frequency of occurrence for six wind-speed categories. By using a representative resuspension rate for each wind-speed category from Fig. 4.1 and the frequency of occurrence of each wind-speed category in the WNW sector, a weighted average resuspension rate is calculated. Table IV-3 summarizes the results of the calculations used to produce the weighted resuspension rate.

An average resuspension rate of 5.2×10^{-11} 1/s is estimated for the WNW sector from the PHERMEX test-firing area. Using Equation 4 and a surface contamination of 1 g/m^2, a source rate of $5.2 \times 10^{-10} g/m^2/s$ is calculated for the base-case scenario.

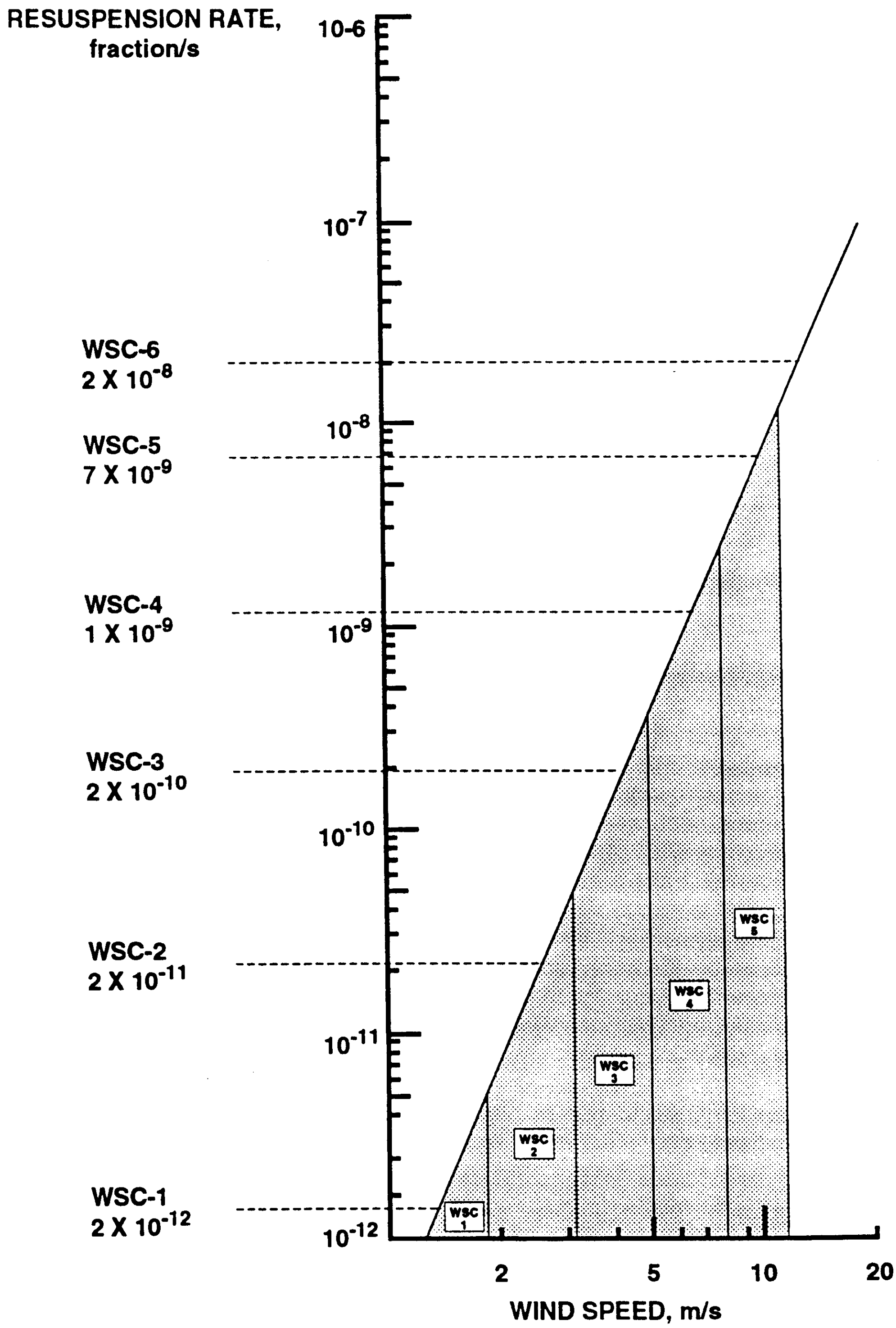


Figure 4-1 Resuspension rate vs. wind speed

Table IV-3 Resuspension Rate to the West-Northwest Direction from PHERMEX

Wind Resuspension Class	Wind-speed Range (m/s)	Resuspension[a] Rate (1/s)	Wind-speed Class % Contribution[b]	Weighted Rate (1/s)
1	0.3 - 1.7	8.0×10^{-12}	47.7	3.8×10^{-12}
2	1.8 - 3.3	7.0×10^{-11}	48.0	3.4×10^{-11}
3	3.4 - 5.3	3.0×10^{-10}	4.2	1.3×10^{-11}
4	5.4 - 8.4	1.0×10^{-9}	0.1	1.0×10^{-12}
5	8.5 - 10.8	3.0×10^{-9}	0.0	0.0
6	>10.9	5.0×10^{-9}	0.0	0.0
Total				5.2×10^{-11}

[a] Fig. 4-1
[b] STAR data for Los Alamos (LANL EM-8)

4.4 Summary of Wind Resuspension Methods

The air concentration in the vicinity of the contaminated surface was calculated in a base-case scenario using a unit-surface contamination of 1 g/m^2. Two methods were employed: resuspension factor and mass loading. These two methods resulted in fair agreement (see Table IV-4) with a difference of a factor of ~4 greater using a resuspension factor method. The difference is partly attributable to the locations where the air monitoring was performed and variations in surface stresses. It is also recognized that the resuspension factor represents a more conservative approach than the mass loading, which uses site-specific data on airborne dust. The air concentration is used to assess occupational exposure to contaminants in the vicinity of the contamination. The more conservative results calculated with the resuspension factor are used in the assessment in Chapter 5 of this appendix.

In addition to air concentrations, the source rate of airborne emissions was calculated using a resuspension-rate model for the base-case scenario of unit contamination of 1 g/m^3 (see Table IV-5). That value is used to assess occupational exposures at downwind locations away from the contaminated areas. The source rate is a contaminant emission rate and is used in conjunction with an air dispersion model to estimate air concentrations downwind.

Table IV-4 Summary of Base-Case Wind-Resuspension Air Concentrations[a]

Surface Characteristic	Local Air Concentration (g/m^3) Resuspension Factor	Mass Loading	Areal Source Rate ($g/m^2/s$)
Undisturbed vegetated soil	1.4×10^{-6}	3.3×10^{-7}	5.2×10^{-11}
Pedestrian or vehicular traffic over unvegetated soil	1.4×10^{-5}	3.3×10^{-6}	5.2×10^{-11}

[a] Assuming 1 g/m^2 surface contamination

Table IV-4 summarizes the results of the base-case wind resuspension parameters. Actual contaminants' air concentrations and source rates can be calculated by multiplying the air concentration in Table IV-5 by the actual surface contamination.

Table IV-5 Base-Case Radiological Dose

Location	Exposure Duration (hr)	Nuclide	Air Concentration (Ci/m^3)	EDE (rem)	Lung Dose (rem)
Firing Area[a]	416	U-234	5.2×10^{-13}	0.025	0.21
		U-235	7.4×10^{-14}	0.003	0.025
		U-238	5.1×10^{-12}	0.310	2.58
		Pa-234		5.1×10^{-6}	4.3×10^{-6}
		Pa-234m[d]	----	1.8×10^{-5}	1.6×10^{-5}
		Th-234[d]	----	1.6×10^{-5}	1.2×10^{-5}
R-310[b]	988	U-234	5.2×10^{-14}	0.0059	0.05
		U-235	7.4×10^{-15}	0.0007	0.0058
		U-238	5.1×10^{-13}	0.0740	0.62
R-183[c]	936	U-234	3.0×10^{-20}	4.5×10^{-9}	3.8×10^{-8}
		U-235	4.0×10^{-21}	5.5×10^{-10}	4.6×10^{-9}
		U-238	2.8×10^{-19}	3.8×10^{-8}	3.2×10^{-7}
Total	2340			0.419	3.49

[a] Base-case air concentration is 1.5×10^{-5} g/m^3
[b] Base-case air concentration is 1.5×10^{-6} g/m^3
[c] Base-case source rate is 5.2×10^{-11} $g/m^2/s$
[d] Exposure is from ground-shine; DU base-case surface contamination is 1 g/m^2

5.0 Radiological Dose Assessment

Potential exposure to personnel occurs via the inhalation, air-immersion, and ground-shine pathways. Exposure from ingestion is assumed not to exist because foodstuffs are not produced on-site. DU is an alpha-emitter, so the inhalation pathway poses the most significant radiological exposure. The LANL course entitled Radiation Worker Safety Training emphasizes the alpha emissions from DU. A small contribution is made by the ground-shine pathway from the accumulation of DU on the ground surface in the test area. Exposure from air-immersion is very small compared to the inhalation dose and may be disregarded. Doses are calculated only for the inhalation and ground-shine pathways.

5.1 Inhalation Dose Assessment

With point sources, an Environmental Protection Agency (EPA) dose assessment code, such as CAP-88 (EPA, 1991), could be used to perform the necessary dose calculations. The methodology, however, for estimating effects of wind resuspension results in an air concentration rather than in a release rate. As a consequence, CAP-88 or another EPA-approved dose assessment code cannot be used in this dose assessment. Instead, a method similar to CAP-88 is used

$$D = C * B * DCF * T \quad (6)$$

where,

D = the inhalation dose (rem),

C = the radionuclide air concentration (μCi/m^3),

B = the breathing rate (m^3/s),

DCF = the radionuclide inhalation dose conversion factor (rem/μCi) and

T = the duration of exposure (s).

The standard breathing rate is 3.4×10^{-4} m^3/s. Inhalation dose conversion factors used to calculate EDE and the critical organ (lung) doses are summarized in Table V-1. Appropriate air concentrations and exposure times are discussed in Chapter 6 of this appendix.

The dose calculated by Eq. 5 is for a single radionuclide. The total dose is the sum of inhalation doses contributed by each radionuclide. With DU, there are three significant radionuclides including U-234, U-235, and U-238.

Table V-1 Dose Conversion Factors

	Effective Dose Equivalent		Critical Organ [a]	
Radionuclide	**Inhalation[b] (rem/μCi)**	**Ground-shine[c] ($mrem\text{-}m^2/\mu Ci/yr$)**	**Inhalation[b] (rem/μCi)**	**Ground-shine[c] ($mrem\text{-}m^2/\mu Ci/yr$)**
U-238	120.0	0.065	1000.0	0.012
U-235	120.0	17.1	1000.0	13.9
U-234	130.0	0.081	1100.0	0.017
Pa-234m	NA[d]	1.13	NA[d]	0.99
Pa-234	7.4×10^{-4}	196.0	3.3×10^{-3}	171.0
Th-234	0.033	1.01	0.24	0.74

[a] The critical organ is the lung

[b] DOE 1988b

[c] DOE 1988a

[d] NA: not found in DOE, 1988b; this radionuclide is not a significant contributor to the dose

5.2 Ground-Shine Dose Assessment

A small contribution to the EDE is possible from the accumulation of gamma-emitting radiation from ground-shine. This exposure pathway is normally insignificant and, therefore, neglected when inhalation of an alpha-emitting radionuclide, such as U, is present. In this analysis, however, the source of airborne radionuclides is from the wind resuspension of surface material and only a tiny fraction of surface material becomes airborne. This raises the suspicion that ground-shine exposure may be greatly elevated relative to the inhalation exposure; consequently, the calculation of the EDE includes the ground-shine pathway. There is also a contribution from larger fragments. It is estimated there is one fragment for each square meter within a 137 meter radius of the firing point.

As with the inhalation dose, use of an EPA dose assessment code such as CAP-88 is not practical. A method similar to the CAP-88 is employed:

$$D = S * DCF * T \quad (7)$$

where,

D = the inhalation dose (mrem),

S = the radionuclide surface concentration ($\mu Ci/m^2$),

DCF = the radionuclide ground-shine dose conversion factor ($mrem\text{-}m^2/\mu Ci\text{-}yr$), and

T = the duration of exposure (yr).

Dose conversion factors used in calculating the EDE are summarized in Table V-1. Appropriate surface concentrations and exposure times are discussed in Chapter 6 of this appendix. The dose calculated using Equation 6 is for a single radionuclide. The total dose is the sum of ground-shine doses contributed by each radionuclide.

6.0 Base-Case Exposure Scenario

The calculation of the maximum occupational exposure is based on the work schedule of the most exposed worker. Three different work areas are considered. The first two are at PHERMEX: Building R-310 and the firing point, and the third area is at the complex known as area 183 which comprises several buildings, including R-183, R-313, and R-286. These are shown in Figure 1-1. The exposure scenario in this assessment estimates exposure to the same worker while pursuing work activities in these three locations. The total exposure received is the sum of the three individual exposures. The exposure scenario for each of the three locations is discussed in the remainder of this chapter.

An aerial survey was conducted to estimate surface contamination around PHERMEX. (See Chapter 3 of this appendix and also Appendix G.) Results from the survey show a circular configuration of surface contamination roughly centered on the test-firing area. Maximum contamination exists near the test-fire area. Levels of contamination decrease radially from the center until a distance of ~137 m is reached.

For the base-case scenario, the center of contamination is defined to have a surface contamination level of 1 g/m^2; this includes the test-firing area. Exposure scenarios for other locations that are a routine part of the work schedule are based on this level of surface contamination.

6.1 Work Schedule

The exposure scenarios are based on the assumption that tests are conducted at a rate of ~1/wk for a total of 52 tests/yr. The same worker is present for each test. A worker may elect not to take vacation or other time away from the work place, so it is conservatively assumed that there are 2340 hr spent at the work place/yr. This amounts to 260 days (52 wk) of 9 hr/day (8:00 a.m. to 5:00 p.m.) including a one-hr lunch break spent on site.

6.2 Exposure at the PHERMEX Test-site Firing Point

A typical test at PHERMEX lasts 1 wk. Of that, a technician or engineer can spend 1 full day at the firing point. However, a 1-hr lunch break is assumed to occur in building 310 adjacent to the test-fire area. This yields a total exposure time at the test-fire area, of one 8 hr/test for 52 tests/yr or 416 hr/yr. An additional 52 hr/yr are spent in building 310 during lunch break.

In reality a typical test scenario consists of the following:

1 day preparing cabling and setting up control room at R-310

1 day tuning up PHERMEX and verifying radiation dose and spot size

1 day dry runs

1 day actual test

1 day clean up.

The test-firing region is near the center of the contaminated region where contamination is maximum. The surface contamination here has been defined in the base-case scenario as 1 g/m^2.

The most conservative contaminant air concentration at the test firing area is from the wind resuspension model described in Chapter 4 of this appendix. At this location, exposure to personnel from wind resuspension of soil occurs without any protection afforded by buildings or other means. Moreover, the firing area is unvegetated and receives considerable pedestrian traffic, some vehicular traffic, and other mechanical stresses at the surface, such as routine firing point cleanup involving raking and cleaning of debris from the soil. From Table IV-4, an air concentration of 1.4×10^{-5} g/m^3 is used. By ignoring snow and rain, especially snow, which is present for several months of the year, the results shown are ultra conservative.

The inhalation dose resulting from exposure in the test-firing area is calculated from Equation 5. The resulting dose is due mainly to inhalation of U-238. Table IV-5 summarizes the inhalation and ground-shine doses calculated at building R-310.

Air concentrations of nonradiological contaminants have a base-case value of 1.5×10^{-5} g/m^3. Table VI-1 summarizes the nonradiological air concentrations for the base-case.

Table VI-1 Base-Case Nonradiological Air Concentrations[a]

Location	Air Contaminant	Concentration (g/m^3)
Firing Area	Be	1.5×10^{-5}
	Pb	"
	Hg	"
R-310	Be	1.5×10^{-6}
	Pb	"
	Hg	"
R-183	Be	8.1×10^{-13}
	Pb	"
	Hg	"

[a] Base-case source rate is 5.2×10^{-11} g/m^2/s

6.3 Exposure Inside Building R-310

During a typical 1 wk test, two days are spent inside building R-310 adjacent to the test-fire area. This yields a presence of 18 hr/test for 52 wk, plus the 52 hr/yr from Section 5.2 of this appendix. As a consequence, a total of 988 hr/yr are spent inside building R-310. This figure is used to calculate doses in this study. In addition, R-185 and R-310 are occupied by personnel 5 days a week, whether tests are scheduled or not.

Contaminant air concentrations outside building R-310 are calculated by the wind resuspension factor model described in Section 4.1 of this appendix. Contaminated areas surround building R-310 and the test-fire area located to the northeast. Exposure to personnel from wind resuspension of soil occurs with the wind blowing from all directions. In general, most wind directions are from areas vegetated by grasses and trees and indicative of less surface stresses. Only when the wind is from the east and southeast are particulates brought from the test-firing area. From Table IV-4, an air concentration of 1.4×10^{-6} g/m^3 is used.

It is conservatively assumed that the building does not filter, or otherwise reduce contaminants, from the outside air. Concentrations, therefore, of airborne contaminants are assumed to be the same inside the building as outside.

The inhalation dose resulting from exposure in the test-firing area is calculated from Equation 5. The resulting dose is due mainly to inhalation of U-238. Table IV-5 summarizes the inhalation dose calculated at building R-310.

Air concentrations of nonradiological contaminants have a base-case value of 1.5×10^{-6} g/m^3. Table VI-1 summarizes the nonradiological air concentrations for the base-case.

6.4 Exposure Inside Building R-183

The remaining 2 days of a 1 wk test schedule is spent at area 183, which is 1220 m (4000 ft) to the west-northwest (WNW) of the test-fire area, although people working here rarely visit the firing point. This yields a total annual exposure of 936 hr at building R-183.

Building R-183 is well beyond the firing area and well past the 137 m radial extent of the surface contamination centered near the test-firing area. It is assumed, therefore, that there is no local source of airborne contamination near building R-183. Potential exposure here occurs only when the wind blows out of the east-southeast from the PHERMEX test-firing area and building R-310. During such occasions, wind resuspension from contaminated areas in, and around, the firing area provided a source of exposure. It is conservatively assumed that building R-183 provides no reduction from outside airborne contaminants that arrive from the test-firing area.

Building R-183's source for exposure is the entire contaminated area above background around the firing area described in the aerial survey. This area is

58 600 m^2 with an estimated average contaminant contamination of one-half the maximum in the test-firing area. In the base-case scenario, the test-fire area has a contamination rate of 1 g/m^2. The average contamination across the contaminated area at PHERMEX is, consequently, assumed to be 0.5 g/m^2.

The source rate of emissions to the atmosphere from the entire contaminated area uses a resuspension rate model described in Section 4.3. From Table IV-3, a source rate of 5.2 x 10^{-11} $g/m^2/s$ was calculated for the WNW direction from the test-firing area using site-specific wind data. From Equation 4, a total area source rate of 3.0 x 10^{-6} g/s was calculated for the base-case exposure scenario. This includes releases from the entire 58 600 m^2 of contaminated area at PHERMEX.

The air concentration of contaminant material arriving at buiding R-183 was calculated using the CAP-88 computer code. The air intake for R-183 is from the south side of the building. The resulting air concentration per unit source (X/Q value) of 2.7 x 10^{-7} g/m^3 results in an air concentration of 8.2 x 10^{-13} g/m^3 at building R-183. This result is many orders of magnitude lower than air concentrations calculated for the firing area and building R-310 adjacent to the firing area. This is due to several factors:

- The frequency of wind toward the WNW occurs only 3.1 percent of the time.
- The resuspension rate is very low toward the WNW, because there is a lack of strong wind speeds in this direction. (Table IV-3 shows a zero occurrence of wind-speed classes 5 and 6, which are much larger potential contributors to the weighted average resuspension rate than wind speed classes 1-4.)
- The downwind distance to building R-183 is 1220 m, which allows for considerable air dispersion during transport.

The inhalation dose resulting from exposure in the test-firing area is calculated from Eq. 5. Doses calculated for exposure at building R183 are insignificant and are many orders of magnitude less than exposures received at the test firing area and building R-310.

Air concentrations of nonradiological contaminants are calculated as the product of the source rate and the X/Q value

$$C = S * XQ \qquad (8)$$

where,

C = the air concentration (g/m^3),

S = the source rate (3.0 x 10^{-6} g/s), and

XQ = the Chi/Q value (2.7 x 10^{-7} s/m^3).

The XQ value is calculated by the CAP-88 computer code. The air concentration for the base-case was calculated to be 8.2 x 10^{-13} g/m^3. Table V1-1 summarizes the nonradiological air concentrations for the Base-Case.

7.0 Conclusions

A base-case exposure scenario analysis was conducted in which exposure to contaminants was calculated from a hypothetical surface contamination of 1 g/m^2. Maximum acceptable surface contamination was calculated by dividing the exposure limit by the base-case result. Table VII-1 summarizes the results of the analysis.

Table VII-1 Acceptable Surface Contamination Levels

Contaminant	Base-case Exposure	Exposure Limit	Maximum Acceptable Surface Concentration	
DU	0.42 rem (EDE)	2.0 rem	4.80 g/m^2	15 700 ppm
DU	3.49 rem (lung)	50.0 rem	13.30 g/m^2	43 900 ppm
Be	1.5×10^{-5} g/m^3	2.0 x 10-6 g/m^3	0.13 g/m^2	429 ppm
Pb	1.5×10^{-5} g/m^3	1.5 x 10-4 g/m^3	10.00 g/m^2	33 000 ppm
Hg	1.5×10^{-5} g/m^3	1.0 x 10-5 g/m^3	0.67 g/m^2	2200 ppm

For the radiological contaminant DU, both EDE and lung doses were calculated. The maximum acceptable surface concentration is set by the most limiting radiological dose. In this case, the administrative EDE exposure limit of 2 rem/yr imposes the most restrictive level of 4.8 g/m^2 (15700 µg/g). In Chapter 2 of this appendix, it was seen that current DU surface contamination of about 400 µg/g is present at PHERMEX.

For nonradiological contaminants, maximum acceptable surface concentrations of 0.13 g/m^2 Be (429 µg/g), 10.0 g/m^2 Pb (33 000 µg/g), and 0.67 g/m^2 Hg (2200 µg/g) were calculated. For mercury, the most restrictive chemical form is assumed to exist at PHERMEX because chemical data is not available.

These results are considered to be conservative. Calculations are performed to underestimate levels of maximum acceptable contamination. Methods that help make the result conservative include:

- Schedule that places the worker at the work location for 2340 hr/year.
- Use of resuspension factor rather than mass loading approach. Mass loading yielded lower air concentrations of resuspended contaminants. Mass loading was not used, because it could not be ascertained whether the mass-loading air concentration of 1.5×10^{-5} g/m^3 was indicative of moderate traffic and no vegetation at the test-firing area at PHERMEX.
- Use of a small effective skin depth of 200 µm as recommended (NRC 1983). The effective skin depth is used in the conversion of the area contamination (g/m^2) to the volumetric contamination (µg/g). A smaller value yields a larger ppm value. (See Section 4.2 of this appendix.)
- Exposure scenario included no benefit for mitigating actions that could reduce wind resuspension releases. Simple actions such as

watering the test-firing area during particularly breezy conditions are used.

- PHERMEX is an all weather firing area. Some tests are done during or after rain and snowfall. Resuspension of particulates will be lower during these times.

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GLOSSARY AND ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
DOE	U.S. Department of Energy
DU	depleted Uranium
EDE	effective dose equivalent
EPA	Environmental Protection Agency
ground-shine	An external radiation exposure resulting from gamma rays emitted from radionuclides deposited on the ground surface.
Hg	mercury
LANL	Los Alamos National Laboratory
mass loading	The amount of dust present in the air.
NRC	Nuclear Regulatory Commission
Pa	protactinium
Pb	lead
PM	particulate matter
Pu	plutonium
resuspension factor	A physical quantity which when multiplied by the surface contamination yields a contaminant air concentration above the ground.
resuspension rate	A physical quantity which when multiplied by the surface contamination yields the rate at which surface contamination becomes airborne.
STAR	stability array meteorological data
TA	Technical Area
Th	thorium
TLV	threshold limit value
U	uranium

APPENDIX G

Radiological Survey Methods

APPENDIX G - RADIOLOGICAL SURVEY METHODS

G.1 Introduction

Radiological field surveys are primarily scans of the land surface using direct reading or recording instruments. For the TA-15 OU work plan, radiological surveys are used to identify and refine locations where contamination above screening levels and also above cleanup levels may exist. While negative field survey results are not necessarily conclusive evidence for the absence of elevated levels of radioactive contaminants, the probability that such contamination exists can be minimized with the proper design and execution of radiological surveys. When elevated contamination levels are detected, survey equipment allows the precise location of hot spots to be determined for subsequent discrete soil sampling.

Radiological surveys to detect surface contamination are exceptionally convenient and rapid to carry out. Survey methods have the disadvantage that the x-ray and gamma-ray signatures are strongly attenuated by solid matter, and therefore contamination below the surface (in most cases, depths greater than 1-2 in.) are not detected reliably. A second disadvantage is that minimum detection limits are highly isotope specific, depending upon the nuclear characteristics of the decaying isotope.

G.2 Gross Gamma Surveys

Several instruments available that are suitable for gamma surveys include: micro-R meters, NaI detectors of various sizes (with rate meters and scalers), and Geiger-Müller detectors. The preferred instruments are micro-R meters with the ability to measure 5µR/hr, and 2-in. by 2-in. NaI detectors with a ratemeter capable of displaying 100 cpm. Some discrete-measurement or continuous-measurement instruments also are available using the same detectors. Surveys typically are conducted by carrying these instruments at waist height at a slow walking pace and observing and recording the ratemeter response. Measurement also may be made at the ground surface to aid in identifying the presence of localized contamination. The applicable LANL ER SOP is

- Measurement of Gamma Radiation Using a Sodium Iodide (NaI) Detector

G.3 Low-Energy Gamma Surveys

FIDLER and PHOSWICH instruments are most commonly used to detect radionuclides which emit low-energy gamma and x-ray radiation. Both instruments are optimized to detect low-energy photons, such as the 60 keV gamma emission from americium-241 or the x-rays that accompany the decay of most heavy radionuclides including uranium, plutonium, and other transuranics. Discrete- or continuous-measurement recording options are available. Surveys typically are conducted by carrying the instruments close to the ground surface, or attaching the instruments to tripods, and observing the ratemeter or scalar. Also, measurements may be made at the ground surface to identify and precisely locate highly localized contamination. The applicable SOPs are:

- Near Surface and Soil Sample Screening for Low-Energy Gamma Radiation using the FIDLER
- Near Surface and Soil Sample Screening for Low-Energy Gamma Radiation using the PHOSWICH

G.4 Gamma Spectrometry Systems

The Energy Measurements Division of EG&G-Las Vegas operates the Department of Energy's Remote Sensing Laboratory. This laboratory maintains state of the art ground- and airborne-vehicle based gamma spectrometry systems which have been valuable during a number of environmental studies involving radioactive contamination at DOE, DoD, and other sites (see Table G.4-1). Figure G.4-1 contains photographs of typical tripod-mounted and ground-vehicle based *in situ* systems used in a recent radiological survey of surface soils at the DOE's Rocky Flats Plant. An airborne radiological survey of TA-15 was conducted in 1982 the results of which are given in Appendix H.

Ground-based (*in situ*) gamma spectrometry systems (shown in Figure G.4-1) use liquid nitrogen-cooled high purity germanium (HPGe) detectors mounted on an easily-moved tripod, or on a retractable arm attached to a four-wheel drive vehicle. The retractable arm on the vehicle-based system allows the detector's height above ground to be varied from essentially ground level to about ten meters. A height of about 7.5 meters typically is used, and lead collimators can be used to vary the cone angle available to the detector's sensor.

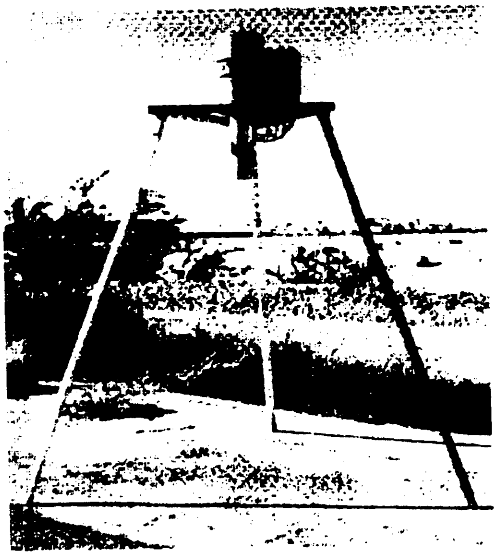
The vehicle also contains a computer processing facility so raw data processing and preliminary contamination mapping can be performed in real time in the field. Subsequent refinement of the data occurs offsite resulting in a map of individual radionuclides (or groups of radionuclides emitting gamma rays of similar energy). Airborne gamma spectrometry systems differ from ground-based systems because they use arrays of sensitive detectors.

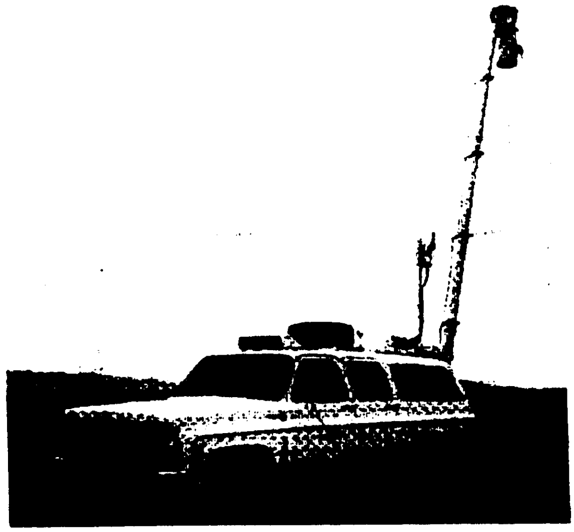
Minimum detectable activities for several radionuclides of interest for the TA-15 OU are listed in Table G.4-2. MDAs are listed for both ground-based (*in situ*) and aerial-based systems. Because gamma-rays are strongly attenuated by solid matter, gamma survey methods are useful only for the uppermost portion of the soil horizon. For example, for the 60 keV emission characterizing americium-241, for a uniform distribution with depth, approximately 95% of the unscattered gamma rays reaching the detector would originate within the top 6 cm of the soil and approximately 99% would originate within the top 9 cm.

Table G.4-1. Past environmental applications of the Remote Sensing Laboratory's gamma spectrometry systems.

SITE	SURVEY LOCATION	DATE	ISOTOPES OF INTEREST	APPLICATION
Eniwetok Atoll	Western Pacific	7/77-12/79	Am^{241}	Cleanup
Gnome	Carlsbad, New Mexico	8/77-9/77	Cs^{137}	Assessment
Johnston Atoll	Western Pacific	4/80-8/80	Am^{241}	Mapping
Middlesex Plant	Middlesex, New Jersey	7/80-11/80	Ra^{226}	Cleanup
Kellex	Jersey City, New Jersey	9/80-11/80 Th^{232}	$U^{235,238}$	Assessment
Area 11	Site	Nevada Test	6/81-9/81	Am^{241} Cleanup
Areas 2, 15, and 21	Los Alamos Natl. Lab.	9/82 Cs^{137}, U^{238}	Am^{241}	Mapping
Areas 1-13, 15-20, 25, 26 and 30	Nevada Test Site	6/81-3/86 Inventory	All measurable	Mapping/
Maralinga	South Australia	5/87-7/87 Cs^{137}, U^{238}	Am^{241},	Survey support
Rocky Flats Plant	Golden, Colorado	12/90 $U^{235,238}$	Am^{241},	Assessment

Figure G.4-1. Photographs of *in situ* gamma spectrometry systems operated by the Remote Sensing Laboratory. Photographs are from EG&G (1990).





Tripod Based Sampling System Suburban Sampling System

Table G.4-2. Typical minimum detectable activities (MDAs) for surface soils using the Remote Sensing Laboratory's *in situ* and helicopter-based gamma spectrometry systems.[1]

ISOTOPE	HELICOPTER[2] μCi/m²	*IN SITU*[3] μCi/m²
Am^{241}	0.1	0.006
Pu^{239}	400	30
U^{235}	0.03	0.003
U^{238}	1.0	0.04
Cs^{137}	0.02	0.002
I^{131}	0.02	0.002
Co^{60}	0.01	0.001

1) An infinite (uniform) surface distribution of radionuclides is assumed. MDAs are from the EG&G reports cited in the reference list. Actual values can vary by a factor of two or more at specific sites, depending upon background.

2) Altitude 30 m, speed 60 knots, 20 NaI(Tl) detectors (12.7 cm x 5.1 cm), 1 second acquisition time.

3) Height 1 m, 20% n-Type High Purity Germanium Detector, 10 min. acquisition time.

Minimum detectable activities also are strongly isotope dependent, as indicated in Table G.4-2. Isotope dependency is due both to the energy of the emission (lower energies are more strongly attenuated and give lower detector response) and the branching factor (fraction of radioactive decays which give rise to gamma ray emission). However, sensitivity is excellent to cesium-137, uranium-235 and -238, and americium-241 (the daughter product of the relatively short lived isotope plutonium-241). Some of these are important contaminants of concern at the TA-15 OU. The spectrometer system can be optimized for specific isotopes of interest in the survey.

The usual approach for deducing uranium distributions from gamma-ray techniques is to measure the more easily-detected signature from protactinium-234m and to assume they are in equitibium and that their activities are equal. This approach assumes that the ratio does not vary over the site due to either partitioning of uranium and protactinium by environmental processes or that uranium-238 and protactinium-234m have reached secular equilibrium since the production of the uranium metal.

Results from radiological surveys usually are expressed in units of $\mu Ci/m^2$. Conversion to units of pCi/g requires some knowledge or assumptions about the vertical and lateral distribution of the radionuclide in the soil.

Source term size also has a strong impact on lower detection limits. Table G.4-3 and Figure G.4-2 give some conversion factors and illustrate the lower sensitivity for point versus uniformly distributed sources. For example, consider a typical *in situ* system configuration with a detector height of 7.4 m and a corresponding field of view of about 300 m^2 (20 m diameter). For a uniform surface distribution of americium-241, the minimum detectable activity (MDA) is about 11 pCi/g, or 0.36 mCi for a point source. This sensitivity is comparable to, or better than, that of FIDLER or PHOSWICH systems (not radionuclide-specific) operating at a height of about one meter above land surface, with a corresponding survey area of several square meters.

Because the information from the aerial radiological survey (Fritzsche 1989, 10-0033) is used extensively in this work plan, the report is reproduced in total as Appendix H .

Figure G.4-2. Typical MDAs and distributed source MDA curve for Rocky Flats buffer zone surface soils. Data are from the report on the *in situ* survey of Rocky Flats (ESG 1991).

ISOTOPE	MDA (pCi/g)
Am^{241}	0.9
Cs^{137}	0.1
U^{238}	4.1
Ra^{226}	0.2
Th^{232}	0.2
K^{40}	0.2

MDA = Minimum Detectable Activity = A/B where

A = Activity read on graph (pCi/g) for B=1

B = Branching rates (gamma/disintegration)

For:
- three standard deviation statistical uncertainty of typical background spectrum
- 15 minute acquisition time
- 20 % Bare N-type HPGe detector
- 7.5 meter detector elevation
- 46 meter grid
- uniform distribution averaged over top 3 cm

Table G.4-3. Geometric factors influencing minimum detectable activities. Data are from the report on the aerial radiological survey of the Rocky Flats Plant (ESG 1990).

TABLE F.4–3

Minimum Detectable Activity for Several Selected Radioisotopes as a Function of Source Geometries			
	Surface Sources		Volume Source
Isotope	Point Source (mCi)	Distributed Source (μCi/m^2 a=∞)	$\left(\frac{pCi}{g}\right)$** a=10cm
Am-241	2.9	0.35	11.2
Cs-137	0.27	0.028	0.35

*Assuming a survey altitude of 46 meters.
**Conversion factor to pCi/g relate to the average of a 5-cm deep soil sample

Finite Am-241 Source Correction Factors Versus Area of Contamination	
Source Diameter (meters)	Correction Factor
10	37
20	9
40	3.5
60	2.2
80	1.6
100	1.3
140	1.1
>140	1.0

Correction Factors Versus Area of Contamination	
Diameter of Contaminated Circular Area (meters)	Correction Factors
5	300
10	100
25	10
50	6.5
100	2.5
200	1.2
300	1.0
∞	1.0

APPENDIX G REFERENCES

EG&G , "An Aerial Radiological Survey of the United States Department of Energy's Rocky Flats Plant and Surrounding Area", EG&G-10617-1044, UC-702, May 1990.(EG&G 1990).

EG&G, "*In Situ* Surveys of United States Department of Energy's Rocky Flats Plants", EGG-10617-1129, UC-702, May 1991 (EG&G 1991).

EG&G , "An *In Situ* Determination of ^{241}Am on Enewetok Atoll", EGG-1183-1778, UC-41, November 1981 (EG&G 1981).

Fritzsche, A. E., September 1989. "An Aerial Radiological Survey of Technical Area 15 and Surroundings Los Alamos National Laboratory," Los Alamos, New Mexico. (Fritzsche 1989, 10-0033)

APPENDIX H

Aerial Radiological Survey
TA-15
EG&G 1982

EG&G
ENERGY MEASUREMENTS

EGG-10282-1095
UC-41
SEPTEMBER 1989

THE
REMOTE SENSING LABORATORY
OPERATED FOR THE U.S.
DEPARTMENT OF ENERGY BY EG&G/EM

AN AERIAL RADIOLOGICAL SURVEY OF

TECHNICAL AREA 15 AND SURROUNDINGS LOS ALAMOS NATIONAL LABORATORY

LOS ALAMOS, NEW MEXICO

DATE OF SURVEY: SEPTEMBER 1982

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EG&G ENERGY MEASUREMENTS

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DATE OF SURVEY: SEPTEMBER 1982

A. E. Fritzsche
Project Scientist

REVIEWED BY

Harvey W. Clark Jr.

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This Document is UNCLASSIFIED

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This work was performed by EG&G/EM for the United States Department of Energy, Office of Nuclear Safety, under Contract Number DE-AC08-83NV10282.

ABSTRACT

An aerial gamma survey of the entire Los Alamos National Laboratory and the adjacent area was flown in September 1982. The data from a part of the survey, Technical Area 15, are presented here. Other parts of the survey data that will complete the presentation will be published in a separate report.

The gamma survey data show significant Pa-234m activity which implies U-238 activity above background levels. Concentration isopleths overlaid on aerial photographs of this area indicate the position and extent of this isotope. The inventory of Pa-234m (above background) is probably between 4 and 23 curies, depending on the actual vertical distribution of the Pa-234m in the soil.

Isopleth maps of the natural background gamma exposure rates and the total exposure rates (natural plus exposure due to Pa-234m) are included. Implied exposure rates at 1 meter above the ground range from a minimum terrestrial component of 6 μR/h to 22 μR/h over areas where Pa-234m and the parent, U-238, exist.

CONTENTS

Appendices

1.0 INTRODUCTION

An aerial gamma survey of the entire Los Alamos National Laboratory and the adjacent area was conducted in September 1982. The survey was performed by EG&G Energy Measurements, Inc. (EG&G/EM) at the request of the U.S. Department of Energy (DOE), Office of Nuclear Safety.

The object of the survey was to measure the natural terrestrial gamma exposure rates as well as the location and intensity of anomalous, man-made gamma emitters. Gamma data from the NaI(Tl) detectors were reduced to exposure and concentration plots overlaid on aerial photographs of Los Alamos.

Because Los Alamos covers a large geographical area, gamma maps of the entire area as well as subsections of the area have been produced. The subject of this report is the subsection around Technical Area 15 (TA-15), an area of approximately 840 hectares (3.2 square miles) which is shown in Figure 1. Pa-234m was detected in this area, which implies the existence of U-238.

2.0 DATA ACQUISITION

The entire Los Alamos area, including the area around TA-15, was surveyed using a Messerschmitt-Bolkow-Blohm (MBB) BO-105 helicopter. Parallel flight lines, east by southeast and west by northwest, were flown under the guidance of a microwave ranging system (MRS). Two transponders on the ground (one at Mt. Cerro Piñon and one at Mt. Glorieta Baldy) and a master unit on the aircraft provided the pilot with a steering vector. Two passes through each of the major Los Alamos canyons were also flown, but not under the guidance of the MRS. The transponder signal generally could not reach the aircraft in the canyons.

An outline of the survey parameters is given in Table 1.

3.0 DATA ANALYSIS

The aerial system uses two primary methods to treat gamma fluence measurements as seen by NaI(Tl) detectors. The first is the gross count (GC) or total gamma count rate, and the second is the spectral window technique. These and other methods are described in detail in a separate publication.[1]

3.1 Gross Count

The gross count is defined as the integral count in the energy spectrum between 38 keV and 3,026 keV.

$$GC = \sum_{38\ \text{keV}}^{3{,}026\ \text{keV}} \text{Energy Spectrum} \qquad (1)$$

This integral includes all the natural gammas from K-40, U-238, and Th-232 (KUT, the major terrestrial, natural gamma emitters). Other natural contributors to this integral are cosmic rays, aircraft background, and airborne radon daughters.

The response versus altitude of the aerial system to terrestrial gammas has been measured over a documented test line near Las Vegas, Nevada, for which the concentrations of KUT and the 1-meter exposure rates have been measured separately. From this calibration, the terrestrial gross count rate has been associated with the 1-meter exposure rate in microroentgens per hour (μR/h) for natural radioactivity. The conversion equation is:

$$ER(1\ m) = \frac{[GC(A)-B]}{1324} \cdot e^{0.001494A} \qquad (2)$$

where

ER = exposure rate
A = altitude in ft
$GC(A)$ = gross count rate at altitude A (cps)
B = cosmic, aircraft, and radon background (cps)

The coefficient, 0.001494, was normalized to the mean air temperature (17.0° C) and pressure (11.2 psi) during the Los Alamos survey.

At Los Alamos, all GC values were normalized to an altitude of 76 meters (250 feet) using Equation 2 because the northern part of the area was flown at 91 meters (300 feet) while the southern part was flown at 61 meters (200 feet). In this way, all count rates were comparable at a common altitude. For $A = 76$ meters, Equation 2 becomes:

$$ER(1\ m) = (GC - B)/912\ \mu R/h \qquad (3)$$

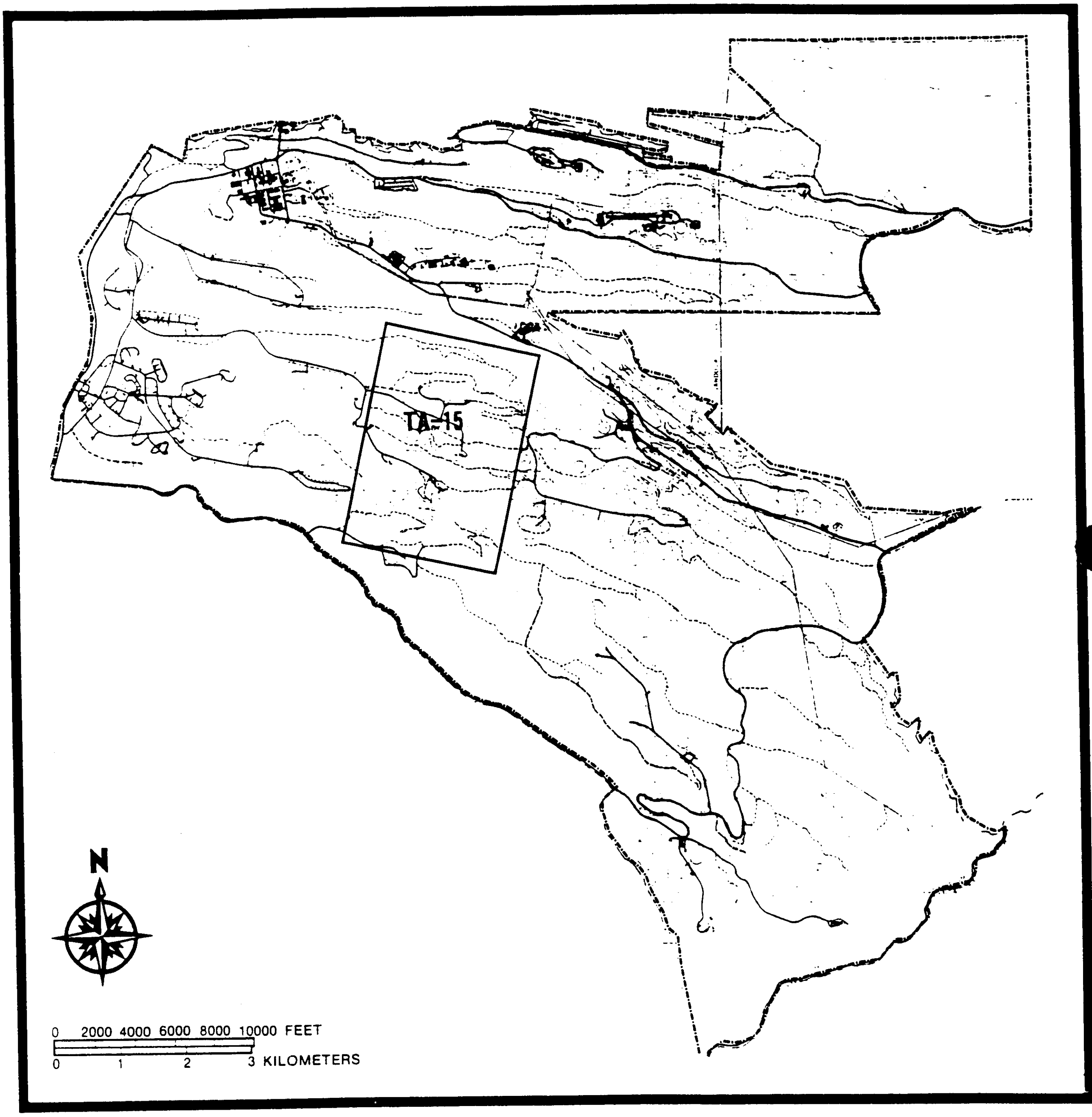


FIGURE 1. ***LOCATION OF TECHNICAL AREA 15 AND SURROUNDING AREA***

Table 1. Hardware, Flight, and Data Parameters	
Aircraft	MBB BO-105 helicopter
Aircraft speed	37 m/s (120 ft/s)
Altitude	61 m (200 ft)
Survey line spacing	91 m (300 ft)
Survey line direction	East by Southeast (~ +102°)
Number of lines	37 on the TA-15 map
Gamma detectors	20, 12.7-cm × 5.1-cm NaI(Tl)
Data recording system	REDAR IV
Data recorded	Gamma spectra, atmospheric temperature and pressure, altitude, and position values from the microwave transponders
Data acquisition rate	Once per second

The gross count has been used for many years in the aerial system as a measure of exposure. Its simplicity yields a rapid assessment of the gamma environment.

Anomalous or non-natural gamma sources are found from increases in the gross count rate over the natural count rates. However, subtle anomalies are difficult to find using the gross count rate in areas where its magnitude is variable due to, for example, geologic or ground cover changes. Differential energy data reduction methods, as discussed in the next section, are used to increase the aerial system's sensitivity to anomalous gamma emitters.

3.2 Spectral Windows

The aerial system produces a gamma energy spectrum each second from which the GC is computed. Generally, the ratio of natural components in any two integral sections (windows) of the energy spectrum will remain nearly constant in any given area:

$$\sum_{E=a}^{b} ES \Big/ \sum_{E=b}^{c} ES = \text{Constant} \qquad (4)$$

where

ES = energy spectrum
E = energy
$c > b > a$

If the window, a–b, is placed where gamma rays from a man-made emitter would occur in the spectrum, the result of Equation 4 could be expected to increase over the constant value. This equation is routinely applied in the data reduction software when a search is made for specific isotopes.

In general, when a search is made for an unknown or non-specific gamma emitter, a and b are set to 38 keV and 1,400 keV, respectively; this range includes most of the long-lived gammas from man-made isotopes. The upper limit of the background window, c, is set at 3,026 keV. This window arrangement is called the man-made gross count (MMGC) ratio.

In practice, the MMGC ratio (Equation 4) was evaluated over background areas of Los Alamos to define the constant, k. Then the following equation was constructed:

$$\text{MMGC} = A - kB \qquad (5)$$

where

$$A = \sum_{E = 38\text{ keV}}^{1{,}400\text{ keV}} \text{Energy Spectrum}$$

$$B = \sum_{E = 1{,}400\text{ keV}}^{3{,}026\text{ keV}} \text{Energy Spectrum}$$

k = constant in Equation 4

The result of Equation 5, when applied to the data, yielded the excess count rates due to man-made gamma emitters.

3.3 Estimated Natural Gross Count

A corollary for the GC (Equation 1) is the estimated natural gross count (ENG) where k is the MMGC ratio of Equation 4. This equation was applied to the Los Alamos data to obtain estimates of the 1-meter exposure rates due to natural gammas and excluded most of the man-made gammas. There were a few areas of Los Alamos where this equation was not useful because gammas of energy greater than 1,400 keV were being generated by operations at the Los Alamos National Laboratory, such as at the LAMPF facility.

$$ENG = (k + 1) \sum_{E = 1{,}400 \text{ keV}}^{3{,}026 \text{ keV}} \text{Energy Spectrum} \qquad (6)$$

Both the GC and ENG equations were applied routinely to the Los Alamos data.

4.0 RESULTS

The primary results of the aerial radiological survey over the TA-15 area of Los Alamos show:

A. The existence of Pa-234m (Figure 2)
B. The isopleths of the Pa-234m concentrations (Figure 3)
C. The 1-meter total terrestrial exposure isopleths (Figure 4)
D. The 1-meter natural exposure isopleths (Figure 5). An inventory estimate of Pa-234m was also made.

4.1 Pa-234m Concentration Isopleths

The net energy spectrum (total less adjacent background) shown in Figure 2, which was observed over Area 1 in Figure 3, indicates the presence of Pa-234m, a daughter of U-238. The shoulder in this spectrum at 186 keV may also indicate the presence of U-235. The photopeaks at 776 keV and 1,000 keV in Figure 2 are rather weak. It has been assumed that the other areas (Areas 2 and 3) in Figure 3 are also due to

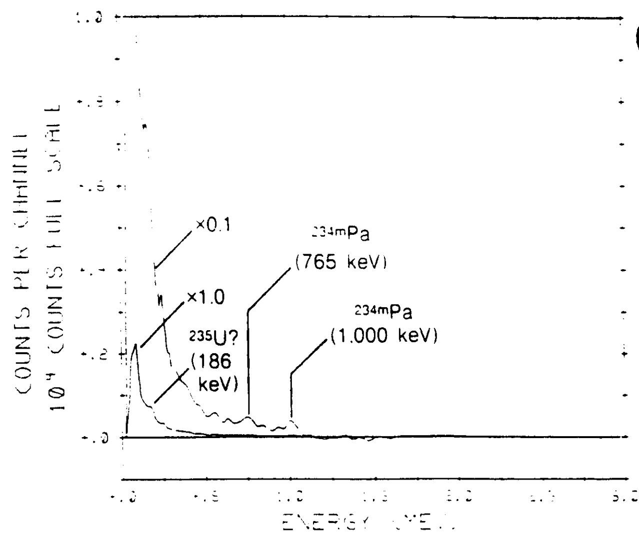


FIGURE 2. ***Pa-234m GAMMA ENERGY SPECTRUM***

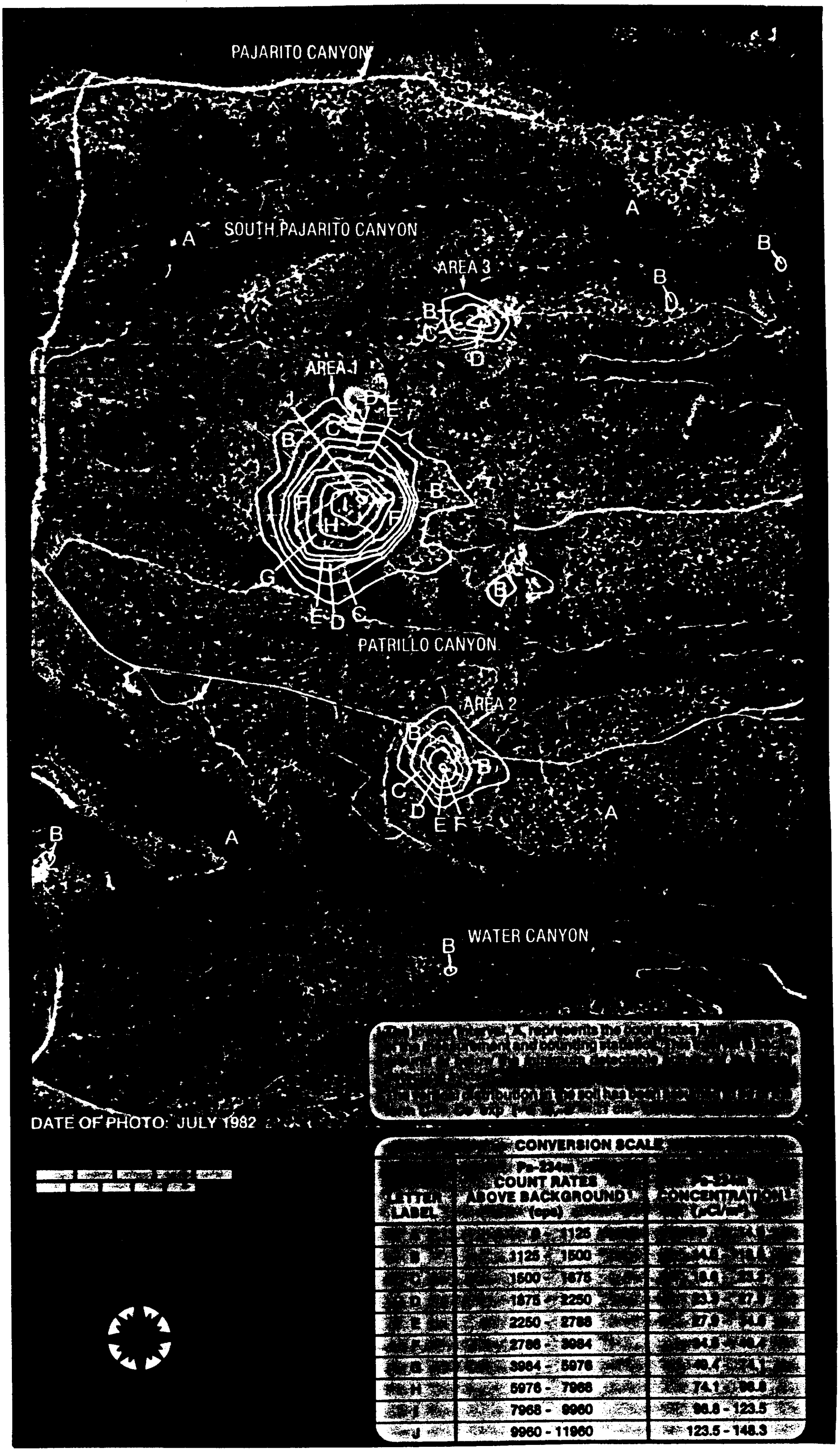
Pa-234m. The photopeaks in the spectra from these areas are less visible than those in Figure 2.

The concentration isopleths in Figure 3 were obtained using the MMGC technique discussed in Subsection 3.2. Since the sensitivity of the aerial system to monoenergetic gamma emitters in the soil may be computed (Appendix A), and the ratio of the 1,000 keV counts to total counts is known from Figure 2, the sensitivity of the MMGC to Pa-234m may be computed also. Some values of MMGC sensitivity, S_A-MMGC, are given in Table 2 for several values of vertical exponential distribution of Pa-234m in the soil. Values for S_v^0 (sensitivity to the ground surface volume) and S_A-Photopeak (sensitivity of the 1,000 keV gamma count rate to the activity per unit area) are also listed.

The other low-level isopleths (Level B) shown in Figure 3 are highly uncertain; they may indicate Pa-234m or may not. That is, they may be generated by the counting statistics. Level B (1,125 cps) represents the 3σ uncertainty level which might be interpreted as the minimum detectable counting level for Pa-234m.

An estimate of the Pa-234m and associated U-238 inventory (Appendix B) can be made from the isopleths in Figure 3. Table 3 lists inventories for three possible concentration distributions.

There are many uncertainties in converting count rates to concentrations. These uncertainties lie in the correct interpretation of the energy spectra (Areas 2 and 3 provided poor spectra); the validity



LETTER LABEL	Pa-234m COUNT RATES ABOVE BACKGROUND (cps)	CONCENTRATION [illegible]
[illegible]	0 - 1125	[illegible]
B	1125 - 1500	[illegible]
C	1500 - 1875	[illegible]
D	1875 - 2250	[illegible]
E	2250 - 2788	[illegible]
F	2788 - 3984	[illegible]
G	3984 - 5976	[illegible]
H	5976 - 7968	74.1 - 98.8
I	7968 - 9960	98.8 - 123.5
J	9960 - 11960	123.5 - 148.3

FIGURE 3. ***CONCENTRATIONS OF Pa-234m AROUND TECHNICAL AREA 15, LOS ALAMOS NATIONAL LABORATORY***

FIGURE 4. *TOTAL TERRESTRIAL EXPOSURE RATE AROUND TECHNICAL AREA 15, LOS ALAMOS NATIONAL LABORATORY*

LETTER LABEL	NATURAL TERRESTRIAL EXPOSURE RATE* AT 1 m AGL (μR/h)
A	6 - 8
B	8 - 10
C	10 - 12
D	12 - 14
E	14 - 16

*The natural terrestrial exposure is measured from the gamma energy spectrum from 1400 keV to 3000 keV. The exposure values are inferred from gamma data taken at an altitude of 61 meters (200 feet). The cosmic exposure is 7.6 μR/h in this area.

FIGURE 5. *NATURAL TERRESTRIAL EXPOSURE RATE AROUND TECHNICAL AREA 15, LOS ALAMOS NATIONAL LABORATORY*

Table 2. Sensitivity to Pa-234m			
α[a] (cm^{-1})	S_v^0 (pCi/cm^3·cps)	S_A-Photopeak[b] (μCi/m^2·cps)	S_A-MMGC (μCi/m^2·cps)
1.0	30.2	0.30	0.0055
0.3	12.1	0.40	0.0073
0.1	6.8	0.68	0.0124
0.03	4.8	1.60	0.0291
0.01	4.3	4.30	0.0782

[a] Vertical concentration parameter in $C = C_0 \exp(-\alpha z)$.
[b] S_A-Photopeak refers to the Pa-234m 1 MeV gamma.

Table 3. Pa-234m Inventory Estimates for TA-15				
	Curies			
α[a] (cm^{-1})	Area 1	Area 2	Area 3	Total
1.0	3.6	0.5	0.1	4.2
0.1	8.10	1.2	0.3	9.6
0.03	19.0	2.8	0.7	22.5

[a] Vertical distribution parameter.

of the concentration distribution model; and the azimuthal smearing of count rates due to the moving aircraft and the large, solid-angle view of the detectors. From experience, however, the uncertainty is expected to be about a factor of two. Appendix C discusses uncertainties in more detail.

4.2 Total Terrestrial Exposure

The total terrestrial exposure isopleth map (Figure 4) indicates the 1-meter exposure from the sum of the natural and man-made terrestrial components. The cosmic and variable airborne radon components are not included on the map.

The exposure levels appear to be above background levels only in Area 1 of this map. About 7.8 hectares (19 acres) are included in Area 1. Areas 2 and 3 (Figure 3) do not show elevated exposure levels in Figure 4, although Area 2 does measure at 1 μR/h above background when a finer isopleth interval (1 μR/h) is used for the plot.

The exposure levels in Area 1 extend to an estimated 20 to 22 μR/h. This may be an underestimate because the aerial system has a wider view of the surface than measurements taken at the 1-meter level.

The natural exposure levels are larger in Water Canyon than on the plateau areas or in Potrillo and Pajarito Canyons. Perhaps the increase is due to the walls of this canyon, which are relatively close together, and may thus contribute more to exposure than do widely-separated walls or a flat plane. The sensitivity of the aerial system to natural terrestrial radiation has been measured for flat plains, not for canyons. The results of specific flights through these canyons at 45-meter (150-foot) altitudes do not indicate the presence of man-made radioactivity.

4.3 Natural Terrestrial Exposure

The natural terrestrial exposure isopleths due to K-40, the U-238 chain, and the Th-232 chain are illustrated in Figure 5. These isopleths were obtained from the fraction of the energy spectrum greater than 1,400 keV, as discussed in Subsection 3.3. Note that the higher exposure levels in Area 1 (Figure 4) do not appear because the Pa-234m gamma rays occur at less than 1,400 keV.

The mean natural background exposure over the map area is 9.5 μR/h. The mean total exposure over the map area is the same, i.e., less than 1 percent larger.

APPENDIX A

AERIAL DETECTOR SENSITIVITIES TO TERRESTRIAL GAMMAS

The EG&G/EM aerial detector system consists of two pods, each containing ten 12.7-cm × 5.1-cm (5-in. × 2-in.) NaI(Tl) cylindrical detectors. The sensitivity of these pods is dependent on several parameters, as listed in Equations 1 and 2 below.

Beginning with a vertical concentration distribution:

$$C(z) = C_0\, e^{-\alpha z} \quad \gamma/cm^3 \cdot s \qquad (1)$$

where

C_0 = the surface concentration, $\gamma/cm^3 \cdot s$

α = exponential concentration factor, cm^{-1}

z = depth in soil, cm

the sensitivity of the pods to a monoenergetic gamma distribution may be written.

$$S_v^0 = \frac{C_0}{cps} = \frac{1}{X} \quad \gamma/cm^3 \cdot s \cdot cps \qquad (2)$$

where

$$X = \frac{A_0}{2} \int_0^{\theta = 90^\circ} \frac{R(\theta)\, e^{-\mu_a h \sec\theta} \tan\theta\, d\theta}{\alpha + \rho \mu_g \sec\theta}$$

A_0 = detector effective area for monoenergetic gamma total absorption in the detector for fluence perpendicular to the ground surface, cm^2

$R(\theta)$ = relative effective area versus the angle, θ, measured from the ground perpendicular to the pod

μ_a = the air mass attenuation coefficient for the gamma energy in question, cm^2/g

μ_g = the soil mass attenuation coefficient for the gamma energy in question, cm^2/g

h = the detector (aircraft) altitudes in units of air thickness, g/cm^2

ρ = soil density, g/cm^3

The sensitivity, S_v^0, may be used to convert a photopeak count rate from the detector or pod output to the soil surface concentration, C_0.

In practice, the effective area, A_0, is measured with known point sources of different energies. The angular factor, $R(\theta)$, is measured and approximated with unity, cosine θ, or a linear combination of these to fit an angular response at a given gamma energy.

Other useful conversions may be obtained from S_v^0. These are:

1. The sensitivity per unit soil surface area

$$S_A = \frac{S_v^0}{\alpha} \quad \gamma/cm^2 \cdot s \cdot cps \qquad (3)$$

2. The sensitivity per unit soil surface mass

$$S_\rho^0 = \frac{S_v^0}{\rho} \quad \gamma/g \cdot s \cdot cps \qquad (4)$$

3. The sensitivity to a soil sample of depth z

$$S_\rho^z = S_v^0 (1 - e^{-\alpha z})/\rho \alpha z \quad \gamma/g \cdot s \cdot cps \qquad (5)$$

The sensitivities in Equations 2, 3, 4, and 5 are for the monoenergetic gammas represented by the photopeaks in the measured energy spectra. Sometimes it is useful to use the total spectrum (Compton's plus photopeak) because the counting statistics have less variance. When using the total spectrum from a particular isotope, a conversion factor from cps to concentration can be obtained from the total spectrum count rate to the photopeak count rate ratio, T/P. The conversion for the total spectrum count rate, then, is simply the monoenergetic conversions of Equation 2, 3, 4, and 5 divided by the total-to-peak ratio.

Example sensitivity:

Suppose we are interested in the sensitivity to the Pa-234m gamma at TA-15, Los Alamos National Laboratory. Assume that the concentration distribution is exponential with a 10-cm relaxation depth such that:

$$C = C_0\, e^{-0.1 z} \quad \gamma/cm^3$$

Other parameters in Equation 1 (the sensitivity equation) are:

$A_0 = 760\ cm^2$

$h = 7.5\ g/cm^2$ (76 m altitude)

$\mu_a = 0.0636\ cm^2/g$

$\mu_g = 0.0636\ cm^2/g$

$\rho = 1.5\ g/cm^2$ (an assumption)

$\alpha = 0.1\ cm^{-1}$

Then from Equation 2:

$1/S_v^0\ [R(\theta) = 1] = 809 \quad cps \cdot cm^3 \cdot s/\gamma$

$1/S_v^0\ [R(\theta) = \cos\theta] = 521 \quad cps \cdot cm^3 \cdot s/\gamma$

The average of the two computations above approximates the angular response of the 12.7-cm × 5.1-cm detector pods.

$$\overline{1/S_v^0} = (809 + 521)/2 = 665 \quad cps \cdot cm^3 \cdot s/\gamma$$

and

$$\overline{S_v^0} = 0.0015 \quad \gamma/cm^3 \cdot s \cdot cps$$

We average the inverse sensitivities, $1/S_v^0$, for the two angular responses to obtain the average response of two systems of equal size, one of isotropic angular response and one of cosine θ.

The other sensitivity values may be computed from S_v^0:

$$S_A = S_v^0/\alpha = 0.0015/0.1 = 0.015 \quad \gamma/cm^2 \cdot s \cdot cps$$

$$S_\rho = S_v^0/\rho = 0.0015/1.5 = 0.0010 \quad \gamma/g \cdot s \cdot cps$$

$$S_\rho^5 = S_v^0(1 - e^{-\alpha z})/\rho \alpha z$$

$$= 0.0015(1 - e^{-0.1 \times 5})/1.5 \times 0.1 \times 5$$

$$= 0.00079 \quad \gamma/g \cdot s \cdot cps$$

To convert any of these sensitivities whose units contain γ/s to pCi, multiply by the inverse of the branching ratio (0.006) times 0.037 disintegration/s·pCi which is 4,505 pCi·s/disintegration.

Finally, the total-to-peak ratio (Compton's plus photopeak divided by the 1 MeV photopeak) is 55. So the photopeak sensitivities above may be converted to total spectrum sensitivity by dividing by 55.

APPENDIX B

RADIOACTIVE INVENTORY COMPUTATION

The EG&G/EM aerial systems gather and compute enough information to estimate a radioactive inventory above the minimum detectable activity in soil. The information used is:

1. A geometric and radiometric scaled isopleth map of the area
2. The mean count rate above background in each isopleth interval
3. The conversion from count rate to a specific isotope concentration distribution in the soil

The area enclosed by each isopleth interval is measured with a suitably fine grid paper and multiplied by the conversion coefficient ($\mu Ci/m^2 \cdot cps$). The sum of these computations for all the isotope intervals yields the inventory. Where the concentration distribution (α) in the Equation $C = C_0 e^{-\alpha z}$ is not well known, a range of inventories may be computed from different α values.

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TECHNICAL AREAS 15
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LOS ALAMOS
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EGG-10282-1095
DATE OF SURVEY: SEPTEMBER 1982
DATE OF REPORT: SEPTEMBER 1989

APPENDIX C

UNCERTAINTIES IN MEASUREMENT AND INTERPRETATION

A number of uncertainties may contribute to misinterpretation of aerial gamma data listed in the contour map or tables of sensitivity and inventory. The sources of uncertainty are contour broadening, basic calibration uncertainty, and airborne gamma emitters.

CONTOUR BROADENING

Contours (or isopleths) are computed from a linear extrapolation to a given magnitude between neighboring, actual data points. One might expect some contour distortion from the finite distance (about 100 ft) over which each data point is collected, but this uncertainty is small compared to that due to source detection, both before and after the detector arrives over the source. Thus, a point source on the ground will appear as a set of concentric circular isopleths or contours centered on a point source. The diameter of the circular contours will depend on the gamma energy of the source, the angular response of the detector, and the intensity of the source as well as the minimum detectable activity of the detection system. The area enclosed by any contour, then, will be enlarged or reduced depending on whether that area contains more or less activity than its surroundings. The aerial measuring system does not have an automated computing method that will convert aerial intensity/position data to source distribution. Rather, informed interpretations of a contour map should be made by technical people.

CALIBRATION UNCERTAINTY

The sensitivity of the aerial gamma system to monoenergetic sources has been measured versus angle in the laboratory. The extrapolation of an aerial photopeak count rate to a source concentration in or on the ground is computed. This method has been verified many times by flying the aerial system over known sources. The uncertainty in such monoenergetic source measurements is 10% or less of the source value.

The sensitivity of the aerial system to natural elements (K-40, U-238 and progeny, and Th-232 and progeny) is checked several times each year from flights at several altitudes over a documented test line beside Lake Mead, Nevada. The test line has been documented by:

1. Counting many soil samples
2. *In situ* NaI(Tl) detector measurements
3. *In situ* high purity germanium detector measurements
4. Ion chamber measurements in a gridded configuration

The aerial total count rate versus altitude yields a curve to extrapolate an aerial measurement to the ground. The uncertainty of the exposure measurement derived from these data is ±7% of the exposure due to KUT (K-40, U-238, and Th-232).

AIRBORNE GAMMA EMITTERS

Radon (Rn-222) daughters are a significant contribution to the gamma count rates measured by the aerial system. Total count rates from Rn-222 vary from zero to perhaps 2,000 cps. This contribution, including that from cosmic rays and aircraft materials, is measured separately for each aircraft flight. A pass over a large body of water (if nearby) is made, or a dual altitude method over a test line is used to compute the total of radon plus cosmic plus aircraft background. In general, the water contains no activity, so the background contributions to the gamma count rate are measured directly. The dual altitude method yields two equations in two unknowns (the terrestrial count rate and the background count rate) and is a less preferable method than using "over water" measurements. The vertical distribution of the radon concentration may be the largest uncertainty in the dual altitude method, and the count rate uncertainty may be as large as 500 cps (~0.5 μR/h) in terms of terrestrial exposure.

REFERENCES

1. Boyns, P.K. July 1976. *The Aerial Radiological Measuring System (ARMS)*: Systems, Procedures and Sensitivity. Report No. EGG-1183-1691. Las Vegas, NV: EG&G/EM.

APPENDIX I

Sampling and Analytical Tables

LIST OF SAMPLING AND ANALYSIS TABLES

The Screening and Analysis Tables in this appendix denote analyses to be carried out for media samples collected during the RFI for the TA-15 OU, as specified in the detailed sampling plans described in Chapters 7 through 10. The numbering of the tables refer back to chapter and section which addresses the specific SWMU.

TABLE 7.3-3 .

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF EF SITE
SWMU 15-004(f)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
15-004(f)																															
soil	surface	0-6	15-1041 15-1042	1			2	2	2	2	2			2	2	2		2			2			1	1	1					
soil	surface	0-6	15-1043				1	1	1	1	1			1	1																
soil	surface	0-6	15-1044				1	1	1	1	1			1	1	1		1			1			1	1	1					
soil	surface	0-6	15-1045				1	1	1	1	1			1	1																
soil	surface	0-6	15-1046				1	1	1	1	1			1	1	1		1			1			1	1	1					
soil	surface	0-6	15-1047				1	1	1	1	1			1	1																
soil	surface	0-6	15-1048				1	1	1	1	1			1	1	1		1													
soil	surface	0-6	15-1049				1	1	1	1	1			1	1																
soil	surface	0-6	15-1050				1	1	1	1	1			1	1	1		1													
soil	surface	0-6	15-1051				1	1	1	1	1			1	1																
soil	surface	0-6	15-1052				1	1	1	1	1			1	1	1		1													
soil	surface	0-6	15-1053				1	1	1	1	1			1	1																

TABLE 7.3-3 (2 of 15)

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF EF SITE
SWMU 15-004(f)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
15-004(f)		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	surface	0-6	15-1054				1	1	1	1	1			1	1	1		1			1			1	1	1					
soil	surface	0-6					1	1	1	1	1			1	1																
soil	surface	0-6					1	1	1	1	1			1	1	1		1			1			1	1	1					
soil	surface	0-6					1	1	1	1	1			1	1																
soil	surface	0-6					1	1	1	1	1			1	1	1		1			1			1	1	1					
soil	surface	0-6					1	1	1	1	1			1	1																
soil	surface	0-6					1	1	1	1	1			1	1	1		1													
soil	surface	0-6					1	1	1	1	1			1	1																
soil	surface	0-6					1	1	1	1	1			1	1	1		1													
soil	surface	0-6					1	1	1	1	1			1	1																
soil	surface	0-6					1	1	1	1	1			1	1	1		1													
soil	surface	0-6					1	1	1	1	1			1	1																

TABLE 7.3-3 (3 of 15)

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF EF SITE
SWMU 16-004(f)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
16-004(f)																															
soil	surface	0-6					1	1	1	1	1			1	1	1		1			1			1	1	1					
soil	surface	0-6					1	1	1	1	1			1	1																
soil	surface	0-6					1	1	1	1	1			1	1	1		1			1			1	1	1					
soil	surface	0-6					1	1	1	1	1			1	1																
soil	surface	0-6		1			2	2	2	2	2			2	2	2		2													
soil	surface	0-6					1	1	1	1	1			1	1																
soil	surface	0-6					1	1	1	1	1			1	1	1		1													
soil	surface	0-6					1	1	1	1	1			1	1																
soil	surface	0-6					1	1	1	1	1			1	1	1		1													
soil	surface	0-6					1	1	1	1	1			1	1																
soil	surface	0-6					1	1	1	1	1			1	1	1		1													
soil	surface	0-6					1	1	1	1	1			1	1																

TABLE 7.3-3(4 of 15)

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF EF SITE
SWMU 15-004(f)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
15-004(f)																															
soil	surface	0-6					1	1	1	1	1			1	1	1		1			1			1	1	1					
soil	surface	0-6					1	1	1	1	1			1	1																
soil	surface	0-6					1	1	1	1	1			1	1	1		1			1			1	1	1					
soil	surface	0-6					1	1	1	1	1			1	1																
soil	surface	0-6					1	1	1	1	1			1	1	1		1													
soil	surface	0-6					1	1	1	1	1			1	1																
soil	surface	0-6					1	1	1	1	1			1	1	1		1													
soil	surface	0-6					1	1	1	1	1			1	1																
soil	surface	0-6					1	1	1	1	1			1	1	1		1													
soil	surface	0-6					1	1	1	1	1			1	1																
soil	surface	0-6					1	1	1	1	1			1	1	1		1													
soil	surface	0-6					1	1	1	1	1			1	1																

TABLE 7.3-3 (5 of 15)

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF EF SITE
SWMU 15-004(f)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION: SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	FIELD SCREENING: GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	LABORATORY ANALYSIS: URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
15-004(f)																															
soil	surface	0-6					1	1	1	1	1			1	1	1		1			1			1	1	1					
soil	surface	0-6					1	1	1	1	1			1	1																
soil	surface	0-6					1	1	1	1	1			1	1	1		1			1			1	1	1					
soil	surface	0-6					1	1	1	1	1			1	1																
soil	surface	0-6					1	1	1	1	1			1	1	1		1													
soil	surface	0-6					1	1	1	1	1			1	1																
soil	surface	0-6					1	1	1	1	1			1	1	1		1													
soil	surface	0-6					1	1	1	1	1			1	1																
soil	surface	0-6					1	1	1	1	1			1	1	1		1													
soil	surface	0-6					1	1	1	1	1			1	1																
soil	surface	0-6					1	1	1	1	1			1	1	1		1													
soil	surface	0-6					1	1	1	1	1			1	1																

TABLE 7.3-3 (6 of 15)
SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF EF SITE
SWMU 15-004(f)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION: SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	FIELD SCREENING: GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	LABORATORY ANALYSIS: URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
15-004(f)																															
soil	surface	0-6					1	1	1	1	1			1	1	1		1			1			1	1	1					
soil	surface	0-6		1			2	2	2	2	2			2	2																
soil	surface	0-6					1	1	1	1	1			1	1	1		1			1			1	1	1					
soil	surface	0-6					1	1	1	1	1			1	1																
soil	surface	0-6					1	1	1	1	1			1	1	1		1													
soil	surface	0-6					1	1	1	1	1			1	1																
soil	surface	0-6					1	1	1	1	1			1	1	1		1													
soil	surface	0-6					1	1	1	1	1			1	1																
soil	surface	0-6					1	1	1	1	1			1	1	1		1													
soil	surface	0-6					1	1	1	1	1			1	1																
equipment	rinse blank	NA					1	1	1	1	1			1	1	1		1			1			1	1	1					
equipment	rinse blank	NA					1	1	1	1	1			1	1	1		1													

TABLE 7.3-3 (7 of 15)
SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF EF SITE
SWMU 15-004(f)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
15-004(f)																															
equipment	rinse blank	NA					1	1	1	1	1			1	1																
TOTAL SURFACE				3	0	0	76	76	76	76	76	0	0	76	76	39	0	39	0	0	16	0	0	15	15	15	0	0	0	0	0

TABLE 7.3-3 (8 of 15)
SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF EF SITE
SWMU 15-004(f)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
15-004(f)																															
soil	subsurface	6		1			2	2	2	2	2			2	2	2					2			2	2	2					
soil	subsurface	6					1	1	1	1	1			1	1																
soil	subsurface	24					1	1	1	1	1			1	1	1					1			1	1	1					
soil	subsurface	24					1	1	1	1	1			1	1																
soil	subsurface	6					1	1	1	1	1			1	1	1					1			1	1	1					
soil	subsurface	6					1	1	1	1	1			1	1																
soil	subsurface	24					1	1	1	1	1			1	1	1					1			1	1	1					
soil	subsurface	24					1	1	1	1	1			1	1																
soil	subsurface	6					1	1	1	1	1			1	1	1					1			1	1	1					
soil	subsurface	6					1	1	1	1	1			1	1																
soil	subsurface	24					1	1	1	1	1			1	1	1					1			1	1	1					
soil	subsurface	24					1	1	1	1	1			1	1																

TABLE 7.3-3 (9 of 15)
SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF EF SITE
SWMU 16-004(f)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
16-004(f)																															
soil	subsurface	6					1	1	1	1	1			1	1	1															
soil	subsurface	6		1			2	2	2	2	2			2	2																
soil	subsurface	24					1	1	1	1	1			1	1	1															
soil	subsurface	24					1	1	1	1	1			1	1																
soil	subsurface	6					1	1	1	1	1			1	1	1															
soil	subsurface	6					1	1	1	1	1			1	1																
soil	subsurface	24					1	1	1	1	1			1	1	1															
soil	subsurface	24					1	1	1	1	1			1	1																
soil	subsurface	6					1	1	1	1	1			1	1	1															
soil	subsurface	6					1	1	1	1	1			1	1																
soil	subsurface	24					1	1	1	1	1			1	1	1															
soil	subsurface	24					1	1	1	1	1			1	1																

TABLE 7.3-3 (10 of 15)
SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF EF SITE
SWMU 16-004(f)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
16-004(f)		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	subsurface	6					1	1	1	1	1			1	1	1															
soil	subsurface	6					1	1	1	1	1			1	1																
soil	subsurface	24					1	1	1	1	1			1	1	1															
soil	subsurface	24					1	1	1	1	1			1	1																
soil	subsurface	6					1	1	1	1	1			1	1	1															
equipment	rinse blank	NA					1	1	1	1	1			1	1	1					1			1	1	1					
equipment	rinse blank	NA					1	1	1	1	1			1	1																
TOTAL UNDISTURBED SUBSURFACE				2	0	0	33	33	33	33	33	0	0	33	33	17	0	0	0	0	8	0	0	8	8	8	0	0	0	0	0

TABLE 7.3-3 (11 of 15)
SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF EF SITE
SWMU 16-004(f)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
16-004(f)		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	DISTURBED SOIL subsurface	6					1	1	1	1	1			1	1	1					1			1	1	1					
soil	DISTURBED SOIL subsurface	6		1			2	2	2	2	2			2	2																
soil	DISTURBED SOIL subsurface	6					1	1	1	1	1			1	1	1															
soil	DISTURBED SOIL subsurface	6					1	1	1	1	1			1	1																
soil	DISTURBED SOIL subsurface	6					1	1	1	1	1			1	1	1															
soil	DISTURBED SOIL subsurface	6					1	1	1	1	1			1	1																
soil	DISTURBED SOIL subsurface	24					1	1	1	1	1			1	1	1					1			1	1	1					
soil	DISTURBED SOIL subsurface	24					1	1	1	1	1			1	1																
soil	DISTURBED SOIL subsurface	24					1	1	1	1	1			1	1	1															
soil	DISTURBED SOIL subsurface	24					1	1	1	1	1			1	1																
soil	DISTURBED SOIL subsurface	24					1	1	1	1	1			1	1	1															
soil	DISTURBED SOIL subsurface	24					1	1	1	1	1			1	1																

TABLE 7.3-3 (12 of 15)
SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF EF SITE
SWMU 16-004(f)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
16-004(f)																															
equipment	rinse blank	NA					1	1	1	1	1			1	1																
TOTAL DISTURBED SUBSURFACE				1	0	0	14	14	14	14	14	0	0	14	14	6	0	0	0	0	2	0	0	2	2	2	0	0	0	0	0
TOTAL ALL SUBSURFACE				3	0	0	47	47	47	47	47	0	0	47	47	23	0	0	0	0	10	0	0	10	10	10	0	0	0	0	0
TOTAL ALL SAMPLES				6	0	0	123	123	123	123	123	0	0	123	123	62	0	39	0	0	26	2	0	25	25	2	0	0	0	0	0

TABLE 7.3-3 (13 of 15)

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF DEBRIS PILE AT EF SITE
SWMU 15-008(e)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	surface	0-6		1			2	2	2	2	2			2	2	2		2			2			2	2	2					
soil	surface	0-6					1	1	1	1	1			1	1	1		1			1			1	1	1					
soil/debris	surface	0-6					1	1	1	1	1			1	1	1		1			1			1	1	1					
equipment	rinse blank	NA					1	1	1	1	1			1	1	1		1			1			1	1	1					
TOTAL				1	0	0	5	5	5	5	5	0	0	5	5	5	0	5	0	0	5	0	0	5	5	5	0	0	0	0	0

TABLE 7.3-3 (14 of 15)

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF EF SITE
SWMU 15-009(e)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
sludge	surface	0-6				1	2	2	2	2	2			2	2	2		2		2	2			2	2	2		2		2	2
sludge	surface	0-6					1	1	1	1	1			1	1	1		1		1	1			1	1	1		1		1	1
equipment	rinse blank	NA					1	1	1	1	1			1	1	1		1		1	1			1	1	1		1		1	1
cooler	trip blank	NA					1																							1	
TOTAL				0	0	1	5	4	4	4	4	0	0	4	4	4	0	4	0	4	4	0	0	4	4	4	0	4	0	5	4

TABLE 7.3-3 (15 of 15)

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF TRANSFORMER STATION AT EF SITE
SWMU C-15-004

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	surface	0-6		1			2												2										2		
soil	surface	0-6					1												1										1		
equipment	rinse blank	NA					1												1										1		
TOTAL				1	0	0	4	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	4	0	0

TABLE 8.3-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF FIRING SITE (AB)
SWMU 15-004(b) and 15-004(c)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	surface	0-6		1			2	2	2	2	2			2	2			2			2			2	2						
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	subsurface	24					1	1	1	1	1			1	1			1			1			1	1						
soil	subsurface	24					1	1	1	1	1			1	1			1			1			1	1						
soil	subsurface	24					1	1	1	1	1			1	1			1			1			1	1						
soil	subsurface	24					1	1	1	1	1			1	1			1			1			1	1						
soil	subsurface	24					1	1	1	1	1			1	1			1													
soil	subsurface	24					1	1	1	1	1			1	1			1													
soil	subsurface	24					1	1	1	1	1			1	1			1													
soil	subsurface	24					1	1	1	1	1			1	1			1													
soil	subsurface	24					1	1	1	1	1			1	1			1													
equipment	rinse blank	NA					1	1	1	1	1			1	1			1			1			1	1						
TOTAL				1	0	0	20	20	20	20	20	0	0	20	20	0	0	20	0	0	10	0	0	10	10	0	0	0	0	0	0

TABLE 8.4-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF FIRING SITE C
SWMU 15-004(a) and 15-004(d)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	subsurface	24		1			2	2	2	2	2			2	2			2			2			2	2						
soil	subsurface	24					1	1	1	1	1			1	1			1			1			1	1						
soil	subsurface	24					1	1	1	1	1			1	1			1			1			1	1						
soil	subsurface	24					1	1	1	1	1			1	1			1			1			1	1						
soil	subsurface	24					1	1	1	1	1			1	1			1													
soil	subsurface	24					1	1	1	1	1			1	1			1													
soil	subsurface	24					1	1	1	1	1			1	1			1													
soil	subsurface	24					1	1	1	1	1			1	1			1													
soil	subsurface	24					1	1	1	1	1			1	1			1													
equipment	rinse blank	NA					1	1	1	1	1			1	1			1			1			1	1						
TOTAL				1	0	0	20	20	20	20	20	0	0	20	20	0	0	20	0	0	10	0	0	10	10	0	0	0	0	0	0

TABLE 8.5-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF FIRING SITE G
SWMU 15-004(g)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	surface	0-6		1			2	2	2	2	2			2	2			2			2			2	2						
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	subsurface	24					1	1	1	1	1			1	1			1			1			1	1						
soil	subsurface	24					1	1	1	1	1			1	1			1			1			1	1						
soil	subsurface	24					1	1	1	1	1			1	1			1			1			1	1						
soil	subsurface	24					1	1	1	1	1			1	1			1			1			1	1						
soil	subsurface	24					1	1	1	1	1			1	1			1													
soil	subsurface	24					1	1	1	1	1			1	1			1													
soil	subsurface	24					1	1	1	1	1			1	1			1													
soil	subsurface	24					1	1	1	1	1			1	1			1													
soil	subsurface	24					1	1	1	1	1			1	1			1													
equipment	rinse blank	NA					1	1	1	1	1			1	1			1			1			1	1						
TOTAL				1	0	0	20	20	20	20	20	0	0	20	20	0	0	20	0	0	10	0	0	10	10	0	0	0	0	0	0

TABLE 8.5-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF FIRING SITE G
SWMU 15-001

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
soil	surface	0-6		1			2	2	2	2	2			2	2			2			2			2	2						
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
equipment	rinse blank	NA					1	1	1	1	1			1	1			1			1			1	1						
TOTAL				1	0	0	5	5	5	5	5	0	0	5	5	0	0	5	0	0	5	0	0	5	5	0	0	0	0	0	0

TABLE 8.5-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF FIRING SITE G
SWMU 15-008(c)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	surface	0-6		1			2	2	2	2	2			2	2			2			2			2	2						
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
equipment	rinse blank	NA					1	1	1	1	1			1	1			1			1			1	1						
TOTAL				1	0	0	4	4	4	4	4	0	0	4	4	0	0	4	0	0	4	0	0	4	4	0	0	0	0	0	0

TABLE 8.5-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF FIRING SITE G
SWMU 15-009(i)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
sludge	surface	0-6				1	2	2	2	2	2			2	2			2		2	2			2	2			2		2	2
sludge	surface	0-6					1	1	1	1	1			1	1			1		1	1			1	1			1		1	1
equipment	rinse blank	NA					1	1	1	1	1			1	1			1		1	1			1	1			1		1	1
cooler	trip blank	NA					1																							1	
TOTAL				0	0	1	5	4	4	4	4	0	0	4	4	0	0	4	0	4	4	0	0	4	4	0	0	4	0	5	4

TABLE 8.5-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF FIRING SITE G
SWMU AOC C-15-001

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
soil	surface	0-6		1			2	2	2	2	2			2	2			2			2			2	2						
equipment	rinse blank	NA					1	1	1	1	1			1	1			1			1			1	1						
TOTAL				1	0	0	4	4	4	4	4	0	0	4	4	0	0	4	0	0	4	0	0	4	4	0	0	0	0	0	0

TABLE 8.6-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF SWMUs ASSOCIATED WITH PHERMEX
SWMU AOC C-15-011

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	subsurface	120				1	2													2										2	2
soil	subsurface	120					1													1										1	1
equipment	rinse blank	NA					1													1										1	1
cooler	trip blank	NA					1																							1	
TOTAL				0	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	5	4

TABLE 8.6-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF SWMUs ASSOCIATED WITH PHERMEX
SWMU 15-010(c)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	subsurface	24				1	2				2		2	2	2		2			2	2		2	2	2		2			2	2
soil	subsurface	24					1				1		1	1	1		1			1	1		1	1	1		1			1	1
equipment	rinse blank	NA					1				1		1	1	1		1			1	1		1	1	1		1			1	1
cooler	trip blank	NA					1																							1	
TOTAL				0	0	1	5	0	0	0	4	0	4	4	4	0	4	0	0	4	4	0	4	4	4	0	4	0	0	5	4

TABLE 8.6-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF FIRING SITE H
SWMU 15-004(h)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
equipment	rinse blank	NA					1	1	1	1	1			1	1			1			1			1	1						
equipment	rinse blank	NA					1	1	1	1	1			1	1			1													
TOTAL				2	0	0	28	28	28	28	28	0	0	28	28	0	0	28	0	0	15	0	0	15	15	0	0	0	0	0	0

TABLE 8.6-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF FIRING SITE H
SWMU 15-004(h)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	surface	0-6		1			2	2	2	2	2			2	2			2			2			2	2						
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	subsurface	24		1			2	2	2	2	2			2	2			2			2			2	2						
soil	subsurface	24					1	1	1	1	1			1	1			1													
soil	subsurface	24					1	1	1	1	1			1	1			1			1			1	1						
soil	subsurface	24					1	1	1	1	1			1	1			1													
soil	subsurface	24					1	1	1	1	1			1	1			1			1			1	1						
soil	subsurface	24					1	1	1	1	1			1	1			1													
soil	subsurface	24					1	1	1	1	1			1	1			1			1			1	1						
soil	subsurface	24					1	1	1	1	1			1	1			1													
soil	subsurface	24					1	1	1	1	1			1	1			1			1			1	1						
soil	subsurface	24					1	1	1	1	1			1	1			1													
soil	subsurface	24					1	1	1	1	1			1	1			1			1			1	1						
soil	subsurface	24					1	1	1	1	1			1	1			1													

TABLE 8.7-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF UNAMED BURN PIT
SWMU 15-002

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						1
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						1
soil	subsurface	24				1	2	2	2	2	2			2	2			2		2	2			2	2					2	2
soil	subsurface	24					1	1	1	1	1			1	1			1		1	1			1	1					1	1
equipment	rinse blank	NA					1	1	1	1	1			1	1			1		1	1			1	1					1	1
cooler	trip blank	NA					1																							1	
TOTAL				0	0	1	7	6	6	6	6	0	0	6	6	0	0	6	0	4	6	0	0	6	6	0	0	0	0	5	6

TABLE 9.1-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF MDA N
SWMU 15-007(a)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	surface	0-6					1	1	1	1	1	1	1	1	1	1		1			1	1	1	1	1	1					1
soil	surface	0-6					1	1	1	1	1	1	1	1	1	1		1			1	1	1	1	1	1					1
soil	surface	0-6					1	1	1	1	1	1	1	1	1	1		1			1	1	1	1	1	1					1
soil	surface	0-6					1	1	1	1	1	1	1	1	1	1		1			1	1	1	1	1	1					1
soil	surface	0-6					1	1	1	1	1	1	1	1	1	1		1													
soil	surface	0-6					1	1	1	1	1	1	1	1	1	1		1													
soil	surface	0-6					1	1	1	1	1	1	1	1	1	1		1													
soil	subsurface	24				1	2	2	2	2	2	2	2	2	2	2		2		2	2	2	2	2	2	2				2	2
soil	subsurface	24					1	1	1	1	1	1	1	1	1	1		1		1	1	1	1	1	1	1				1	1
soil	subsurface	24					1	1	1	1	1	1	1	1	1	1		1		1	1	1	1	1	1	1				1	1
soil	subsurface	24					1	1	1	1	1	1	1	1	1	1		1		1	1	1	1	1	1	1				1	1
soil	subsurface	24					1	1	1	1	1	1	1	1	1	1		1		1											
soil	subsurface	24					1	1	1	1	1	1	1	1	1	1		1		1											
soil	subsurface	24					1	1	1	1	1	1	1	1	1	1		1		1											
equipment	rinse blank	NA					1	1	1	1	1	1	1	1	1	1		1		1	1	1	1	1	1	1				1	1
cooler	trip blank	NA					1																							1	
	TOTAL			0	0	1	17	16	16	16	16	16	16	16	16	16	0	16	0	9	10	10	10	10	10	10	0	0	0	7	10

TABLE 9.1-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF AGGREGATES TO MDA-N
SWMU C-15-005 and C-15-006

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	surface	0-6					1	1	1	1	1	1	1	1	1	1					1	1	1	1	1	1					1
soil	surface	0-6					1	1	1	1	1	1	1	1	1	1					1	1	1	1	1	1					1
soil	surface	0-6					1	1	1	1	1	1	1	1	1	1															
soil	subsurface	24				1	2	2	2	2	2	2	2	2	2	2				2	2	2	2	2	2	2				2	2
soil	subsurface	24					1	1	1	1	1	1	1	1	1	1				1	1	1	1	1	1	1				1	1
soil	subsurface	24					1	1	1	1	1	1	1	1	1	1				1											
equipment	rinse blank	NA					1	1	1	1	1	1	1	1	1	1				1	1	1	1	1	1	1				1	1
cooler	trip blank	NA					1																							1	
TOTAL				0	0	1	9	8	8	8	8	8	8	8	8	8	0	0	0	5	6	6	6	6	6	6	0	0	0	5	6

TABLE 9.2-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF MDA-Z
SWMU 15-007(b)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	surface	0-6					1	1	1	1	1			1	1	1		1			1			1	1	1					1
soil	surface	0-6					1	1	1	1	1			1	1	1		1			1			1	1	1					1
soil	surface	0-6					1	1	1	1	1			1	1	1		1			1			1	1	1					1
soil	surface	0-6					1	1	1	1	1			1	1	1		1			1			1	1	1					1
soil	surface	0-6					1	1	1	1	1			1	1	1		1			1			1	1	1					1
soil	surface	0-6					1	1	1	1	1			1	1	1		1			1			1	1	1					1
soil	surface	0-6					1	1	1	1	1			1	1	1		1			1			1	1	1					1
soil	surface	0-6		1			2	2	2	2	2			2	2	2		2													
soil	surface	0-6					1	1	1	1	1			1	1	1		1													
soil	surface	0-6					1	1	1	1	1			1	1	1		1													
soil	surface	0-6					1	1	1	1	1			1	1	1		1													
soil	surface	0-6					1	1	1	1	1			1	1	1		1													
soil	surface	0-6					1	1	1	1	1			1	1	1		1													
soil	surface	0-6					1	1	1	1	1			1	1	1		1													

TABLE 9.2-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF MDA-Z
SWMU 15-007(b)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	subsurface	24				1	2	2	2	2	2			2	2	2		2		2	2			2	2	2				2	2
soil	subsurface	24					1	1	1	1	1			1	1	1		1		1	1			1	1	1				1	1
soil	subsurface	24					1	1	1	1	1			1	1	1		1		1	1			1	1	1				1	1
soil	subsurface	24					1	1	1	1	1			1	1	1		1		1	1			1	1	1				1	1
soil	subsurface	24					1	1	1	1	1			1	1	1		1		1	1			1	1	1				1	1
soil	subsurface	24					1	1	1	1	1			1	1	1		1		1	1			1	1	1				1	1
soil	subsurface	24					1	1	1	1	1			1	1	1		1		1	1			1	1	1				1	1
soil	subsurface	24					1	1	1	1	1			1	1	1		1		1											
soil	subsurface	24					1	1	1	1	1			1	1	1		1		1											
soil	subsurface	24					1	1	1	1	1			1	1	1		1		1											
soil	subsurface	24					1	1	1	1	1			1	1	1		1		1											
soil	subsurface	24					1	1	1	1	1			1	1	1		1		1											
soil	subsurface	24					1	1	1	1	1			1	1	1		1		1											
soil	subsurface	24					1	1	1	1	1			1	1	1		1		1											
equipment	rinse blank	NA					1	1	1	1	1			1	1	1		1		1											
equipment	rinse blank	NA					1	1	1	1	1			1	1	1		1						1	1	1					1
cooler	trip blank	NA					1																							1	
TOTAL				1	0	1	32	31	31	31	31	0	0	31	31	31	0	31	0	16	14	0	0	15	15	15	0	0	0	9	15

TABLE 9.3-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF DISPOSAL AREA
SWMU 15-008(b)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	surface	0-6		1			2	2	2	2	2			2	2			2			2			2	2						
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	subsurface	24					1	1	1	1	1			1	1			1			1			1	1						
soil	subsurface	24					1	1	1	1	1			1	1			1			1			1	1						
equipment	rinse blank	NA					1	1	1	1	1			1	1			1			1			1	1						
TOTAL				1	0	0	12	12	12	12	12	0	0	12	12	0	0	12	0	0	6	0	0	6	6	0	0	0	0	0	0

TABLE 10.1-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF SURFACE DRAINAGE (SWMU 15-011(c) AND RELATED SWMUS)
SWMU 15-011(c) AND RELATED SWMUS 15-011(b), 15-014(i), 15-014(j), AND AOC C-15-007)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS *										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	surface	0-6					1	1	1	1	1			1	1		1	1			1			1	1		1				1
soil	surface	0-6					1	1	1	1	1			1	1		1	1			1			1	1		1				1
soil	surface	0-6					1	1	1	1	1			1	1		1	1			1			1	1		1				1
soil	surface	0-6					1	1	1	1	1			1	1		1	1			1			1	1		1				1
soil	subsurface	24				1	2	2	2	2	2			2	2		2			2	2			2	2		2			2	2
soil	subsurface	24					1	1	1	1	1			1	1		1			1	1			1	1		1			1	1
soil	subsurface	24					1	1	1	1	1			1	1		1			1	1			1	1		1			1	1
soil	subsurface	24					1	1	1	1	1			1	1		1			1	1			1	1		1			1	1
equipment	rinse blank	NA					1	1	1	1	1			1	1		1	1		1	1			1	1		1			1	1
cooler	trip blank	NA					1																							1	
TOTAL				0	0	1	11	10	10	10	10	0	0	10	10	0	10	5	0	6	10	0	0	10	10	0	10	0	0	7	10

* NOTE: If field screening results are negative, only semivolatile organics will be analyzed.
If positive, samples will be analyzed for the indicated parameters.

TABLE 10.1-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF SWMUS AT THE HOLLOW
SWMU 15-011(a)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS *										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	subsurface	24				1	2	2	2	2	2			2	2		2			2	2			2	2		2			2	2
soil	subsurface	24					1	1	1	1	1			1	1		1			1	1			1	1		1			1	1
equipment	rinse blank	NA					1	1	1	1	1			1	1		1			1	1			1	1		1			1	1
cooler	trip blank	NA					1																							1	
TOTAL				0	0	1	5	4	4	4	4	0	0	4	4	0	4	0	0	4	4	0	0	4	4	0	4	0	0	5	4

* NOTE: If field screening results are negative, only semivolatile organics will be analyzed.
If positive, samples will be analyzed for the indicated parameters.

TABLE 10.1-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF SWMUS AT THE HOLLOW
SWMU 15-014(k)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS *										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	subsurface	24				1	2	2	2	2	2			2	2		2			2	2			2	2		2			2	2
soil	subsurface	24					1	1	1	1	1			1	1		1			1	1			1	1		1			1	1
equipment	rinse blank	NA					1	1	1	1	1			1	1		1			1	1			1	1		1			1	1
cooler	trip blank	NA					1																							1	
TOTAL				0	0	1	5	4	4	4	4	0	0	4	4	0	4	0	0	4	4	0	0	4	4	0	4	0	0	5	4

* NOTE: If field screening results are negative, only semivolatile organics will be analyzed.
If positive, samples will be analyzed for the indicated parameters.

TABLE 10.1-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF SWMUS AT THE HOLLOW
SWMU AOC C-15-010

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS *											
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	subsurface	24				1	2	2	2	2	2			2	2		2			2	2			2	2		2			2	2
soil	subsurface	24					1	1	1	1	1			1	1		1			1	1			1	1		1			1	1
equipment	rinse blank	NA					1	1	1	1	1			1	1		1			1	1			1	1		1			1	1
cooler	trip blank	NA					1																							1	
TOTAL				0	0	1	5	4	4	4	4	0	0	4	4	0	4	0	0	4	4	0	0	4	4	0	4	0	0	5	4

* NOTE: If field screening results are negative, only semivolatile organics will be analyzed.
If positive, samples will be analyzed for the indicated parameters.

TABLE 10.2-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF SWMU 15-012(b), OPERATIONAL RELEASE
SWMU 15-012(b)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	surface	0-6		1			2	2	2	2	2			2	2			2			2			2	2						
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
soil	surface	0-6					1	1	1	1	1			1	1			1													
soil	subsurface	24					1	1	1	1	1			1	1			1			1			1	1						
soil	subsurface	24					1	1	1	1	1			1	1			1													
soil	subsurface	24					1	1	1	1	1			1	1			1			1			1	1						
soil	subsurface	24					1	1	1	1	1			1	1			1													
soil	subsurface	24					1	1	1	1	1			1	1			1			1			1	1						
soil	subsurface	24					1	1	1	1	1			1	1			1													
equipment	rinse blank	NA					1	1	1	1	1			1	1			1			1			1	1						
TOTAL				1	0	0	14	14	14	14	14	0	0	14	14	0	0	14	0	0	8	0	0	8	8	0	0	0	0	0	0

TABLE 10.2-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF SEPTIC SYSTEM ASSOCIATED WITH SWMU 15-012(b), OPERATIONAL RELEAS
SWMU 15-009(j)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
sludge	surface	0-6		1			2	2	2	2	2			2	2			2			2			2	2			2			
sludge	surface	0-6					1	1	1	1	1			1	1			1			1			1	1			1			
equipment	rinse blank	NA					1	1	1	1	1			1	1			1			1			1	1			1			
TOTAL				1	0	0	4	4	4	4	4	0	0	4	4	0	0	4	0	0	4	0	0	4	4	0	0	4	0	0	0

TABLE 10.2-4

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF OUTFALLS FROM BUILDING TA-15-183
SWMU 15-014(a) and 15-014(b)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS*										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil/sediment	surface	0-6					1						1										1								1
soil/sediment	surface	0-6					1						1										1								1
soil/sediment	surface	0-6					1						1										1								1
soil/sediment	surface	0-6					1						1										1								1
soil/sediment	surface	0-6					1						1										1								1
soil/sediment	surface	0-6					1						1										1								1
soil/sediment	subsurface	24				1	2						2							2			2							2	2
soil/sediment	subsurface	24					1						1							1			1							1	1
equipment	rinse blank	NA					1						1							1			1							1	1
cooler	trip blank	NA					1																							1	
TOTAL				0	0	1	11	0	0	0	0	0	10	0	0	0	0	0	0	4	0	0	10	0	0	0	0	0	0	5	10

* NOTE: If field screening results are negative, only semivolatile organics will be analyzed.
If positive, samples will be analyzed for the indicated parameters.

TABLE 10.2-4

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF SWMUs ASSOCIATED WITH OUTFALLS FROM BUILDING TA-15-183
SWMU 15-009(f)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS *										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
sludge	surface	0-6					1	1	1	1	1		1	1	1			1		1	1		1	1	1			1		1	1
sludge	surface	0-6				1	2	2	2	2	2		2	2	2			2		2	2		2	2	2			2		2	2
equipment	rinse blank	NA					1	1	1	1	1		1	1	1			1		1	1		1	1	1			1		1	1
cooler	trip blank	NA					1																							1	
TOTAL				0	0	1	5	4	4	4	4	0	4	4	4	0	0	4	0	4	4	0	4	4	4	0	0	4	0	5	4

* NOTE: If field screening results are negative, only semivolatile organics will be analyzed.
If positive, samples will be analyzed for the indicated parameters.

TABLE 10.2-4

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF SWMUs ASSOCIATED WITH OUTFALLS FROM BUILDING TA-15-183
SWMU 15-009(k)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS *										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
sludge	surface	0-6				1	2	2	2	2	2		2	2	2			2		2	2		2	2	2			2		2	2
sludge	surface	0-6					1	1	1	1	1		1	1	1			1		1	1		1	1	1			1		1	1
equipment	rinse blank	NA					1	1	1	1	1		1	1	1			1		1	1		1	1	1			1		1	1
cooler	trip blank	NA					1																							1	
TOTAL				0	0	1	5	4	4	4	4	0	4	4	4	0	0	4	0	4	4	0	4	4	4	0	0	4	0	5	4

* NOTE: If field screening results are negative, only semivolatile organics will be analyzed.
If positive, samples will be analyzed for the indicated parameters.

TABLE 10.2-4

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF SWMUs ASSOCIATED WITH BUILDING TA-15-183; CONTAINER STORAGE AREAS
SWMU 15-005(b)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS *										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	surface	0-6		1			2	2	2	2	2			2	2			2			2			2	2						
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
equipment	rinse blank	NA					1	1	1	1	1			1	1			1			1			1	1						
TOTAL				1	0	0	4	4	4	4	4	0	0	4	4	0	0	4	0	0	4	0	0	4	4	0	0	0	0	0	0

* NOTE: If field screening results are negative, only semivolatile organics will be analyzed.
If positive, samples will be analyzed for the indicated parameters.

TABLE 10.2-4

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF SWMUs ASSOCIATED WITH BUILDING TA-15-183; CONTAINER STORAGE AREA AT FIRING POINT C
SWMU 15-005(c)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS *										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil	surface	0-6		1			2	2	2	2	2			2	2			2			2			2	2						
soil	surface	0-6					1	1	1	1	1			1	1			1			1			1	1						
equipment	rinse blank	NA					1	1	1	1	1			1	1			1			1			1	1						
TOTAL				1	0	0	4	4	4	4	4	0	0	4	4	0	0	4	0	0	4	0	0	4	4	0	0	0	0	0	0

* NOTE: If field screening results are negative, only semivolatile organics will be analyzed.
If positive, samples will be analyzed for the indicated parameters.

TABLE 10.3-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF SWMUS AT R40
SWMU 15-014(h)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS*										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
soil/sediment	subsurface	24				1	2						2							2			2							2	2
soil/sediment	subsurface	24					1						1							1			1							1	1
soil/sediment	subsurface	24					1						1							1											
soil/sediment	subsurface	24					1						1							1											
equipment	rinse blank	NA					1						1							1			1							1	1
cooler	trip blank	NA					1																							1	
TOTAL				0	0	1	7	0	0	0	0	0	6	0	0	0	0	0	0	6	0	0	4	0	0	0	0	0	0	5	4

* NOTE: If field screening results are negative, only semivolatile organics will be analyzed.
If positive, samples will be analyzed for the indicated parameters.

TABLE 10.3-2

SCREENING AND ANALYSIS FOR OU 1086
PHASE I SAMPLING PLAN SUMMARY OF SWMUS AT R40
SWMU 15-010(b)

SAMPLING LOCATION/TYPE	SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION						FIELD SCREENING													LABORATORY ANALYSIS *										
		SAMPLE DEPTH (INCHES)	SAMPLE I.D. NUMBER	FIELD DUPLICATE	FIELD SPLIT	COLLOCATED SAMPLE	TOTAL SAMPLES	GROSS ALPHA	GROSS BETA	GROSS GAMMA	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	ORGANIC VAPOR	URANIUM	THORIUM	SILVER	BERYLLIUM	LEAD	MERCURY	CHROMIUM	HIGH EXPLOSIVES	PCBs	VOCs	SVOCs
sludge	surface	0-6		1			2											2										2			
sludge	surface	0-6					1											1										1			
soil/sediment	surface	0-6					1											1										1			
soil/sediment	surface	0-6					1											1										1			
equipment	rinse blank	NA					1											1										1			
TOTAL				1	0	0	6	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	6	0	0	0

* NOTE: If field screening results are negative, no sample will be sent for laboratory analysis.
If positive, all samples will be sent for laboratory analysis.

APPENDIX J

Work Plan Contributors
TA-15

APPENDIX J
TA-15 OPERABLE UNIT WORK PLAN CONTRIBUTORS: EDUCATION AND RELEVANT EXPERIENCE

I. ADMINISTRATIVE MANAGEMENT AND TECHNICAL CONTRIBUTORS

NAME AND AFFILIATION	EDUCATION/EXPERTISE	ER PROGRAM ASSIGNMENT
Caroline Mason, INC-9	Ph.D. Inorganic Chemistry * 18 years experience at Los Alamos in hydrogen energy research and in international scientific developments, including environmental issues abroad.	Operable Unit Project Leader, FY 93
Allen Ogard, INC-9	Ph.D. Inorganic Chemistry * 13 years experience at Los Alamos in research on the thermodynamics of nuclear materials, 19 years involved in the Yucca Mountain and Radionuclide Migration Projects, and 2 years in the DOE Office of Arms Control in Washington as a technical expert assigned to the Threshold Test Ban Treaty Negotiations.	Operable Unit Project Leader, FY 92
Tracy Glatzmaier, EES-5	M.S. Industrial Engineering * 7 years experience in engineering and project design and management; data acquisition and analysis of atmospheric transport and diffusion.	Programmatic Project Leader
Robert Vocke, EM-13	Ph.D. Water Resources * 17 years experience in hazardous waste site assessment, including waste management, regulatory compliance, and program management.	ER Program Manager EM-13 Group Leader

II. TECHNICAL CONTRIBUTORS

NAME AND AFFILIATION	EDUCATION/EXPERTISE	ER PROGRAM ASSIGNMENT
Robert Charles, INC-9	Ph.D. Geochemistry * 26 years experience in geochemistry and related earth sciences, 18 years in Radiochemistry Division. Two years experience in geochemistry with direct application to the ER program in three operable units.	Geology and Soil Science

P. Gary Eller, INC-9	Ph.D. Inorganic Chemistry * 19 years experience in actinide and environmental chemistry research, process development and line/project management. Over 100 publications in peer-reviewed journals. Member of national and international committees in actinide chemistry. OUPL for TA-21.	Hydrogeochemistry Soil Science
Naomi Becker, EES-3	Ph.D. Civil and Environmental Engineering * 17 years experience in hydrology,with special emphasis in the hydrologic characterization of contaminant migration and transport. Extensive experience in the assessment and appraisal of former waste disposal areas for environmental regulatory compliance with Federal and State regulations.	Hydrology
Kevin J. Walter, ERM: Golder	M. Eng. Environmental Engineering * 16 years experience in environmental investigations/remediation engineering and management.	Sampling Plan Development
Rebecca A. Brown, ERM: Golder	M. S. Geology *2 years experience in environmental investigations specializing in geochemistry of NM soils and tuffs.	Work Plan Development
Larry J. Dziuk, ERM: Golder	Ph. D. Toxicology * 20 years experience in human and environmental toxicology, multimedia risk assessment and hazardous waste site investigation.	Sampling Plan Development
Kathryn D. Bennett, EM-8	M.S. Environmental Science * 2 years experience in NEPA biological activities including Laboratory wetlands evaluation, endangered/threatened species studies, and environmental database development.	NEPA biological evaluation

Teralene Foxx, EM-8	M.S. Biology * 18 years field ecology and waste site characterization experience. Adjunct Professor, University New Mexico. Author of books and publications on plant and fire ecology.	NEPA biological evaluation
Wayne Hansen, EES-15	Ph.D. Radiation Biology * 29 years experience in environmental risk, assessment waste management, and health physics	Risk Assessment
Beverly Larson, EM-8	Ph.D. Candidate in Anthropology * 17 years field experience, including 6 years as Laboratory archaeologist. Adjunct processor, University of New Mexico.	NEPA cultural evaluation
Patrick Longmire, INC-9	Ph.D. in Hydrogeochemistry * 17 years experience in field hydrology and geochemistry, regulatory oversight (NMEID), EMTRA project, and RCRA/CERCLA remediation. Principal Instructor for Ground Water Geochemistry and Geochemical Modeling courses for American Assoc of Groundwater Scientists and Engineers.	Hydrogeochemistry and technical review
Dave McInroy, EM-8	B. S. Biology 8 years experience in waste management activities, including EPA compliance issues.	Technical Team Leader Regulatory Compliance
Mathew Pope, LATA	M.S. Atmospheric Sciences * 12 years experience in air dispersion and also assessment associated with DOE weapons facilities including environmental assessment, facilities analysis, and environmental restoration.	Technical Support Risk Assessment
Roger Rasmussen, Associate	B.S. Physics * 36 years of physics experimentation at the firing sites on OU 1086. Nine years of consulting with various Laboratory divisions since retirement.	Archival research

III. ADMINISTRATIVE SUPPORT

Beverly Dickinson, INC-9	* 20 years office management and 10 years word processing.	Coordination, work plan preparation
Yvonne Herring, INC-9	* 10 years office experience and word processing.	Work plan preparation
Virginia Cleary, IS-1	B.A. Zoology * 23 years experience in technical editing	Technical Editor
David Dander, INC-9	B.S. Environmental Science with an Applied Geology emphasis * Graduate student from Northern Arizona University	Technical Illustrator
Bruce Fretwell, INC-9	B.A. Quantitative Economics and Decision Sciences * Graduate student from University of California, San Diego	Work plan preparation
Tami Wiggins, ERM Golder	M.S. Applied Geology (Environmental Studies) * 8 years of experience in writing environmental assessments.	Work plan preparation