RFI Work Plan for Operable Unit 1148

Environmental Restoration Program

May 1992

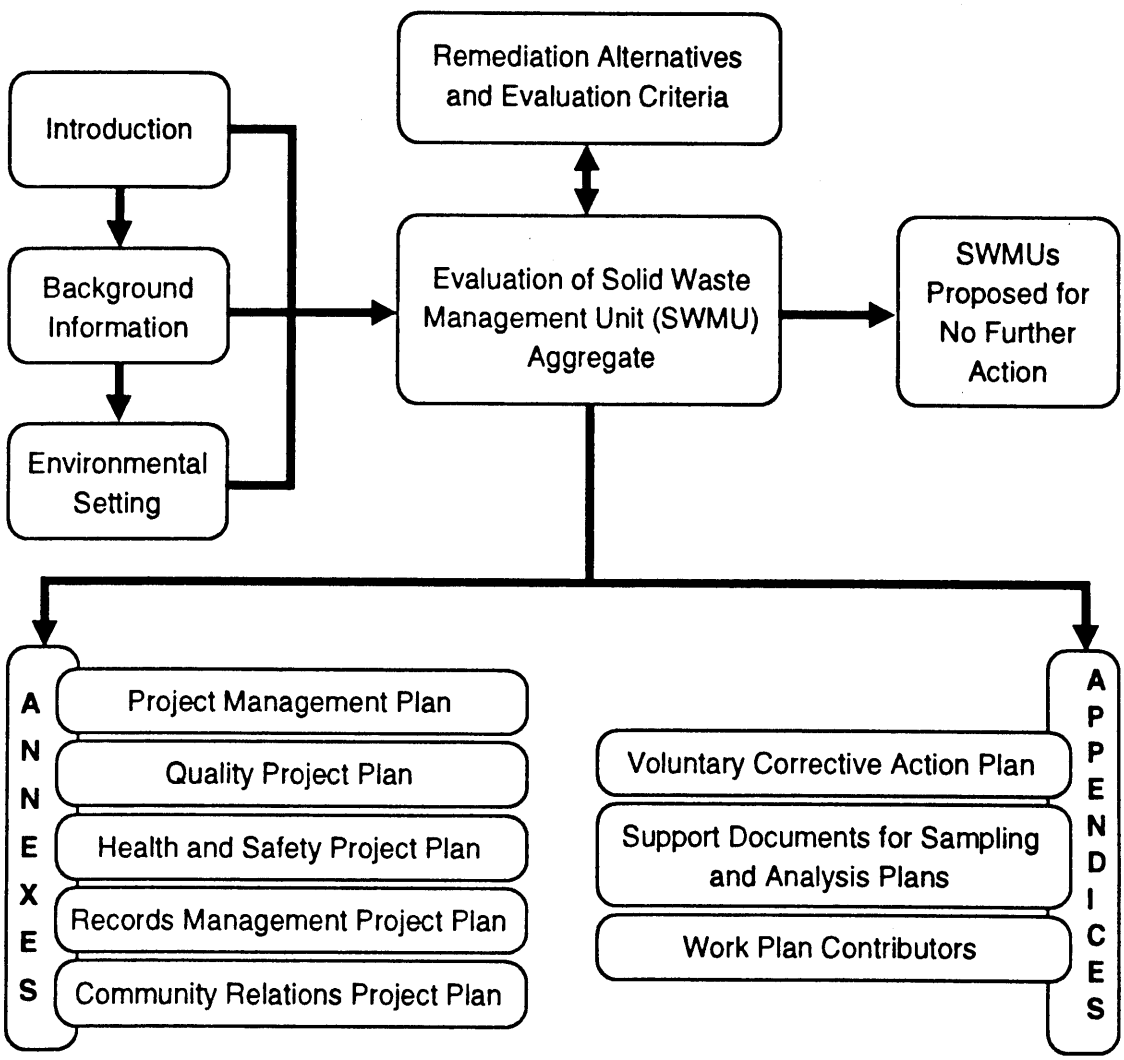
A Department of Energy
Environmental Cleanup Program

Los Alamos
NATIONAL LABORATORY

LA-UR-92-855

EXECUTIVE SUMMARY

RFI WORK PLAN FOR OU 1148



1.0 Introduction

1.1. Purpose

The Operable Unit (OU) 1148 work plan, as part of the Los Alamos National Laboratory's Environmental Restoration (ER) program, is designed to serve two purposes:

- Satisfy the regulatory requirements of the Hazardous and Solid Waste Amendment (HSWA) Module VIII of the Laboratory's Resource Conservation and Recovery Act (RCRA) Part B operating permit, and
- Serve as the field characterization plan for personnel who will implement the RCRA Field Investigation (RFI). Results from the RFI will determine the requirement for any Corrective Measure Studies (CMS).

Module VIII of the RCRA permit was issued by the Environmental Protection Agency (EPA) to address the Department of Energy's (DOE's) Environmental Restoration Program (EPA 1990, 0306). In addition to RCRA requirements, the Laboratory's ER program also is consistent with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

1.2 HSWA Requirements

The OU 1148 work plan is designed to meet scheduled requirements of Module VIII that address a certain percentage of the Laboratory's solid waste management units (SWMUs' i.e., potential release sites) in an RFI work plan to be submitted to the EPA and the New Mexico Environmental Department (NMED) by May 23, 1992. The OU 1148 work plan addresses ten of the 603 SWMUs listed in Table A of the Laboratory's HSWA Module, and addresses three of the 182 SWMUs appearing on the Table B list of priority SWMUs. The OU 1148 work plan thus contributes to the Laboratory's commitment to address cumulative totals of 40% of Table A SWMUs and 55% of Table B SWMUs by May 1992, as required by the HSWA Module.

The expanded list of SWMUs and areas of concern (AOCs) in the 1990 SWMU Report (LANL 1990, 0145) contained 48 SWMUs and three AOCs located in OU 1148. The 1990 SWMU Report included the SWMUs listed in the HSWA Module. The OU 1148 RFI work plan presents a strategy to carry all OU 1148 SWMUs and AOCs listed in the 1990 SWMU Report through the RFI process. As part of the RFI process, a review of available information has led to a recommendation of no further action (NFA) for fourteen of the SWMUs and the three AOCs listed in the 1990 SWMU report. The NFA recommendations include three SWMUs listed in the HSWA module.

1.3 Installation Work Plan

The HSWA Module requires that an installation-wide work plan be prepared to describe the strategy for accomplishing all RFI/CMS work at the Laboratory. This requirement is satisfied by a Laboratory-wide Installation Work Plan (IWP) originally submitted to the EPA on November 19, 1990 (LANL 1990, 0144) and updated annually. The IWP presents the Laboratory's overall management and technical approach for meeting the requirements of the HSWA Module, describes the Laboratory's SWMUs and outlines their aggregation into 23 Operable Units (OUs). All Laboratory OUs are tiered to the IWP and relevant information in the IWP is incorporated by reference. The OU 1148 work plan is in the second set of OU work plans that are necessary to meet the HSWA Module's requirements, as defined in the IWP.

The IWP and the OU 1148 work plan also addresses radioactive materials and other hazardous substances not subject to RCRA regulation. It is understood that language in this work plan pertaining to subjects outside the scope of RCRA is not enforceable under the RCRA Part B operating permit. However, the policy of the Laboratory and the DOE is to conduct the RFI taking into account all hazardous materials, whether or not they are regulated by statute.

1.4 Location and History of Operable Unit 1148

Operable Unit 1148 consists of SWMUs in Technical Areas (TAs) 51 and 54 which are DOE controlled properties. The two TAs are located on an east-west trending mesa (Mesita del Buey) bounded by Cañada del Buey to the north and Pajarito Canyon to the south. The location of Los Alamos National Laboratory and the boundaries of the OU and the TAs are shown in Figures ES-1 and ES-2, respectively. Figure ES-3 shows the locations of SWMUs and AOCs in the Operable Unit.

The three SWMUs in TA-51 include two multiple-celled water-tight structures (caissons) for research studies on the design of covers to protect and isolate waste burial sites and an active septic system. The research caissons have never managed hazardous waste and are recommended for NFA. The septic system is not expected to be contaminated with hazardous substances. However, the septic system will be investigated for contamination after the Laboratory does a sanitary system upgrade.

The 45 SWMUs in TA-54 are organized within four material disposal areas (MDAs) G, H, J, and L and three facilities located in the western part of the TA including TA-54 West, a former radiation exposure facility, and a former animal holding facility.

The 24 SWMUs in MDA G include low-level solid radioactive waste disposal pits and shafts, radioactive waste storage pits and shafts, surface storage of solid radioactive waste, septic systems, sumps, underground tank, a waste compactor, and a truck washing pit. A vapor plume of tritium and volatile organic contaminants is present in the unsaturated rocks immediately below MDA G. An active monitoring program

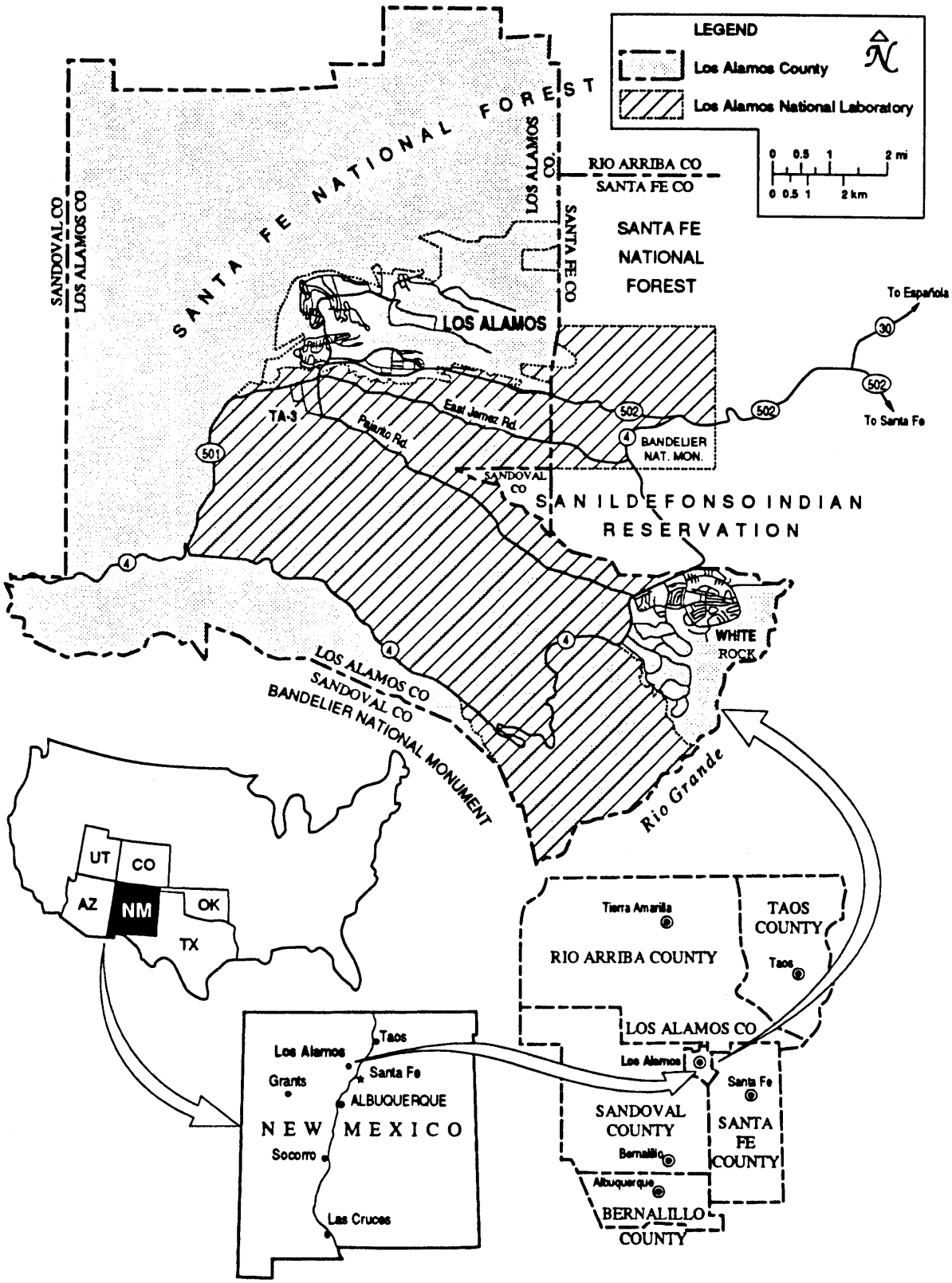


Figure ES-1 Location of Los Alamos National Laboratory.

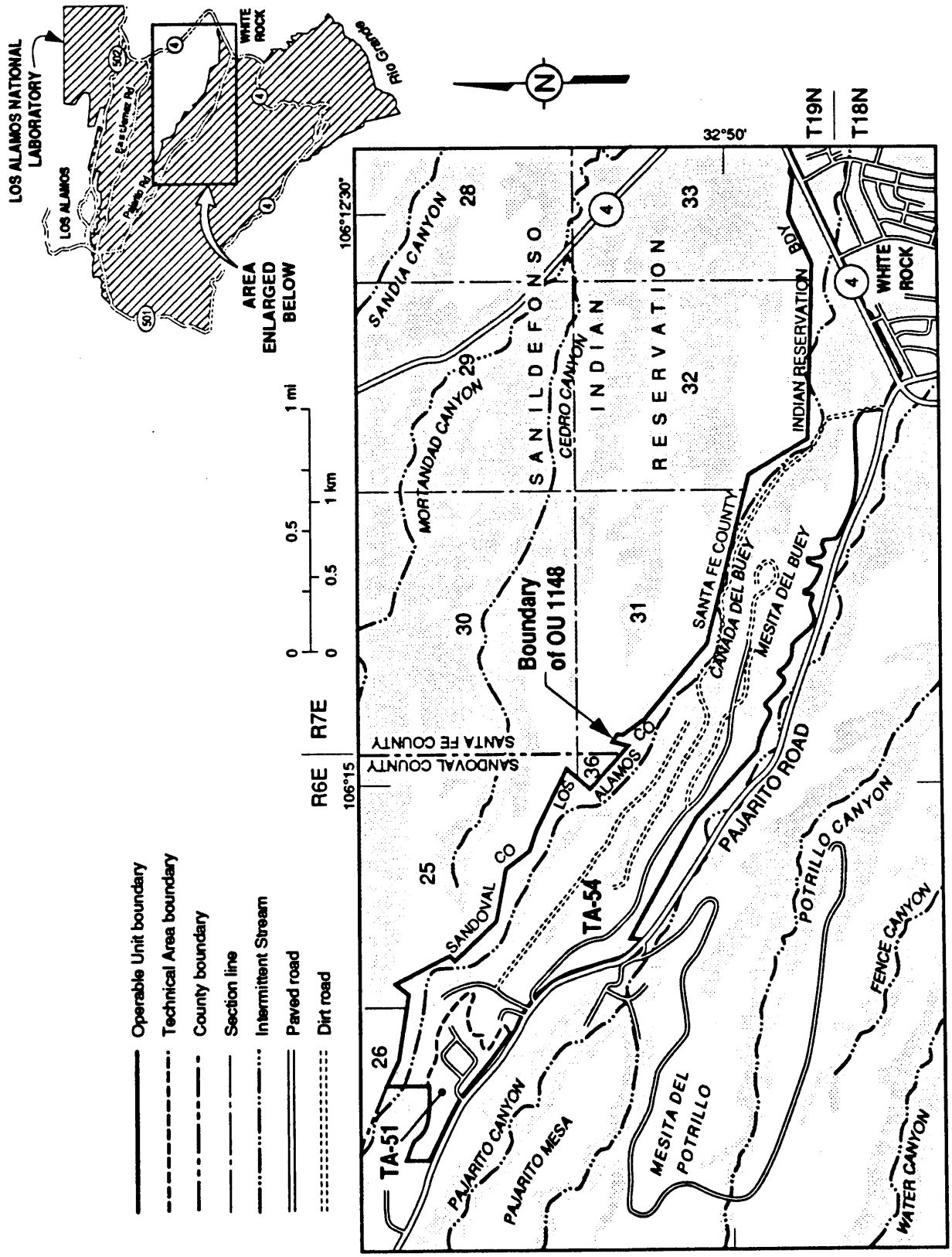


Figure ES-2 Location of TA-51 and TA-54.

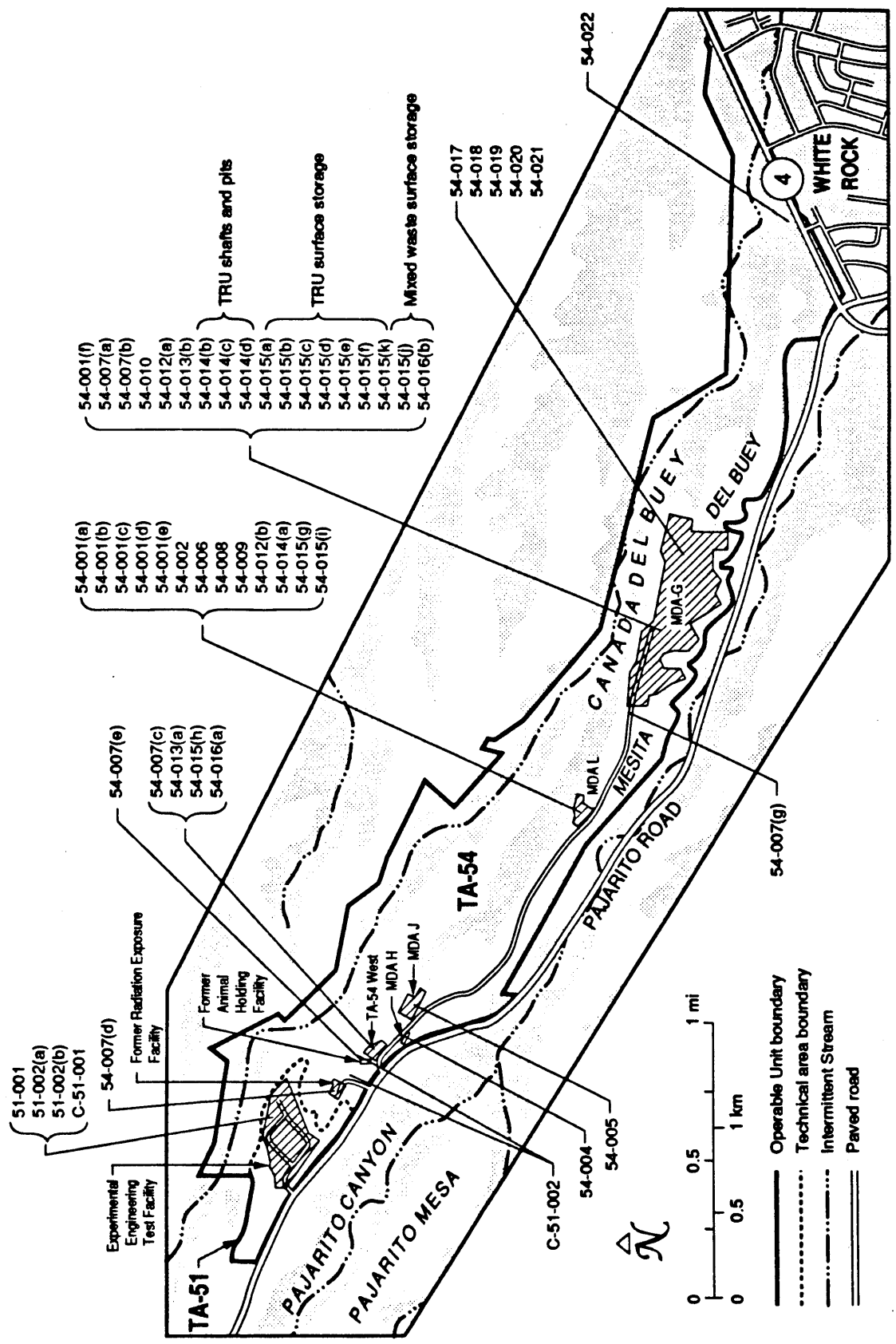


Figure ES-3 Locations of SWMUs and AOCs in OU 1148.

has determined that the plume does not pose a threat for contamination of groundwater at the present time.

The SWMU in MDA H is a set of nine inactive disposal shafts that was used for classified waste. Environmental monitoring and disposal records have shown that tritium was disposed in MDA H.

The SWMU in MDA J includes three pits and two shafts for disposal of nonhazardous waste. There are no known environmental releases from the area.

The 13 SWMUs in MDA L include inactive chemical waste disposal pits, shafts, and impoundments, storage areas for mixed waste, surface treatment and storage areas of hazardous waste, a PCB storage building, a compressed gas cylinder storage area, a drum compactor, and a sanitary waste holding tank. A vapor plume of volatile organic contaminants is present in the unsaturated zone immediately below MDA L. An active monitoring program has determined that the plume does not pose a threat for contamination of groundwater at the present time. The OU 1148 RFI work plan contains a voluntary corrective action plan to remediate the volatile organic contaminant plume at MDA L.

The four SWMUs in TA-54 West include a waste staging area, a sump, a truck washing pit (which was not constructed) and a septic system. TA-54 West is a newly constructed facility for nondestructive testing of TRU waste and has not been placed in operation so there have been no environmental releases. The septic system is not expected to be contaminated with hazardous or radioactive waste. However, it will be investigated for contamination after the Laboratory does a sanitary system upgrade. The other three SWMUs at TA-54 West are recommended for NFA.

The two SWMUs in the former radiation exposure facility and the former animal holding facility are the active septic systems. The systems are not expected to be contaminated with hazardous or radioactive waste. However, they will be investigated for contamination after the Laboratory does a sanitary system upgrade.

2.0 Technical Approach

The technical approach for the OU 1148 RFI is based on the ER program's overall technical approach described in the IWP and includes:

- a phased sampling approach to site characterization;
- application of action levels as a trigger for Corrective Measures Study (CMS);
- decision analysis and cost effectiveness to support selection of remedial alternatives, voluntary corrective action (VCA), or recommendation of no further action (NFA); and

- application of the observational and data quality objective approaches to the RFI/CMS process.

This approach provides an efficient, defensible means of collecting data and generating analyses that will be used to support the VCA, CMS or a recommendation for NFA.

The technical objectives for the OU 1148 Work Plan include:

- identification of potential contaminant migration pathways in OU 1148;
- characterization of the presence and extent of constituents of concern (COCs);
- acquisition of sufficient data to perform risk assessments; and
- provision of sufficient data to plan and perform a VCA, CMS, or recommend NFA, as appropriate.

2.1 Investigative Strategy

The OU 1148 field sampling plans are directed toward groupings of related SWMUs and focuses on contaminant identification and the nature and extent of migration. OU-1148 investigation groups addressed in specific sections of the work plan are listed below.

- MDA G,
- MDA H,
- MDA J,
- MDA L,
- Septic Systems, and
- SWMUs and AOCs recommended for NFA.

The land in OU 1148 will be held under DOE control with eventual transfer to Bandelier National Monument. The sampling plans at the four MDAs are designed to meet requirements of the conditional remedy guidance of RCRA Subpart S. The guidance requires that the MDAs are held under institutional control with restricted access by the general public. The sampling plans for the four septic systems are designed to provide information for recreational use assuming future management of the land by Bandelier National Monument.

Several SWMUs listed in the HSWA Module for OU 1148 are subject to both the corrective action and closure provisions of RCRA. New Mexico Environmental Division (NMED) has authority for closure of these SWMUs. Where appropriate, the closure process will be integrated with the corrective action process, and closure will be implemented as part of the CMS.

To the extent possible, the OU 1148 work plan has been tailored to integrate with RFIs of adjoining technical areas and with the Laboratory's routine environmental surveillance program. The Laboratory ER Program will conduct site-wide background studies (Framework Studies) of hydrology, geology, geochemistry, and other topics to support OU-specific investigations. These studies will have general applicability for all OUs and will only be done once. The Framework Studies section of the OU 1148 work plan is integrated with site-wide investigations that focus on general environmental characteristics to provide a context in which the migration potential of contaminants from OU 1148 SWMUs will be evaluated.

2.2 Analytical Strategy

Sampling plans are developed with field screening to identify grossly contaminated areas. When appropriate, field laboratory analyses are used to provide real time quantitative data to guide field operations. An on-site mobile laboratory, when appropriate, and off-site laboratories will be used to provide high-quality analytical data.

The list of analytes for the MDA G, H, J, and L and septic tank SWMU Aggregates include volatile organic compounds (VOCs), semivolatile organic compounds (SVOC), metals, pesticides, PCBs, cyanide, tritium, gross alpha, gross beta, and gamma spectroscopy. In addition, radionuclides of concern at MDA G have been selected for analyses based on waste disposal records.

2.3 Scope

The RFI field work described in this work plan is expected to require 6 yr to complete, contingent upon the availability of funding. A single phase of field work is expected to be sufficient to complete the RFI for most SWMUs, but a second phase will be executed if field results warrant. A summary of the samples to be collected in the RFI is given in Table ES-1. Table ES-2 and Figure ES-4 summarize the baseline schedule and budget.

3.0 Reports

The HSWA permit specifies the submission of periodic reports, including monthly programmatic status reports and quarterly technical progress reports. During the execution of the OU 1148 RFI status and data will be provided for these reports. At the conclusion of the RFI, a comprehensive report will be prepared that summarizes the entire RFI investigation.

Reports generated during the OU 1148 RFI will be made available for review by the public at the ER Community Reading Room in Los Alamos, New Mexico. The final RFI report, as well as periodic progress reports, also will be made available to the

TABLE ES-1
SUMMARY OF THE SCOPE OF THE OU 1148 RCRA FACILITY INVESTIGATION

Media	Phase I	Phase I QC	Phase I Total	Phase II	Phase II QC	Phase II Total	OU 1148 Total
Surface Water Runoff							
MDA J	1	4	5	13	4	17	22
MDA H	1	4	5	9	4	13	18
MDA L	1	4	5	3	4	7	12
MDA G	9	4	13	9	4	13	26
Surface Sediment							
MDA J	9	4	13	23	8	31	44
MDA H	9	4	13	9	4	13	26
MDA L	9	4	13	6	4	10	23
MDA G	81	20	101	27	8	35	136
Boreholes							
MDA J							
Core	15	16	31	12	16	28	59
Soil Gas	15	16	31	12	16	28	59
MDA H							
Core	24	32	56	24	32	56	112
Soil Gas	24	32	56	24	32	56	112
MDA L							
Core	126	144	270	64	80	144	414
Soil Gas	126	144	270	64	80	144	414
MDA G							
Core	30	40	70	44	64	108	178
Soil Gas	30	40	70	44	64	108	178

TABLE ES-1, (Cont)
SUMMARY OF THE SCOPE OF THE OU 1148 RCRA FACILITY INVESTIGATION

Media	Phase I	Phase I QC	Phase I Total	Phase II	Phase II QC	Phase II Total	OU 1148 Total
Passive Air							
MDA J	26	7	33	--	--	--	33
MDA L	136	30	166	20	6	26	192
MDA G	324	70	394	40	8	48	442
^{3}H Soil							
MDA J	13	3	16	3	3	6	22
MDA G	162	18	180	3	2	5	185
^{3}H Air							
MDA H	12	24	36	18	6	24	60
MDA G	96	10	106	--	--	--	106
Vapor Monitoring							
MDA L	99(2)	20(2)	119(2)	--	--	--	119(2)
MDA G	7(2)	4(2)	11(2)	--	--	--	11(2)
High-Volume Air							
MDA L							
PUF/XAD	48	24	72	3	4	7	72
Glass-Fiber	48	24	72	3	4	7	72
Soil							
MDA G							
PUF/XAD	96	24	120	--	--	--	120
Glass-Fiber	96	24	120	--	--	--	120

TABLE ES-1, (Cont)
SUMMARY OF THE SCOPE OF THE OU 1148 RCRA FACILITY INVESTIGATION

Media	Phase I	Phase I QC	Phase I Total	Phase II	Phase II QC	Phase II Total	OU 1148 Total
Vegetation	--	--	--	9	4	13	13
Septics	16	8(a)	24(a)	12	8	20	44(a)

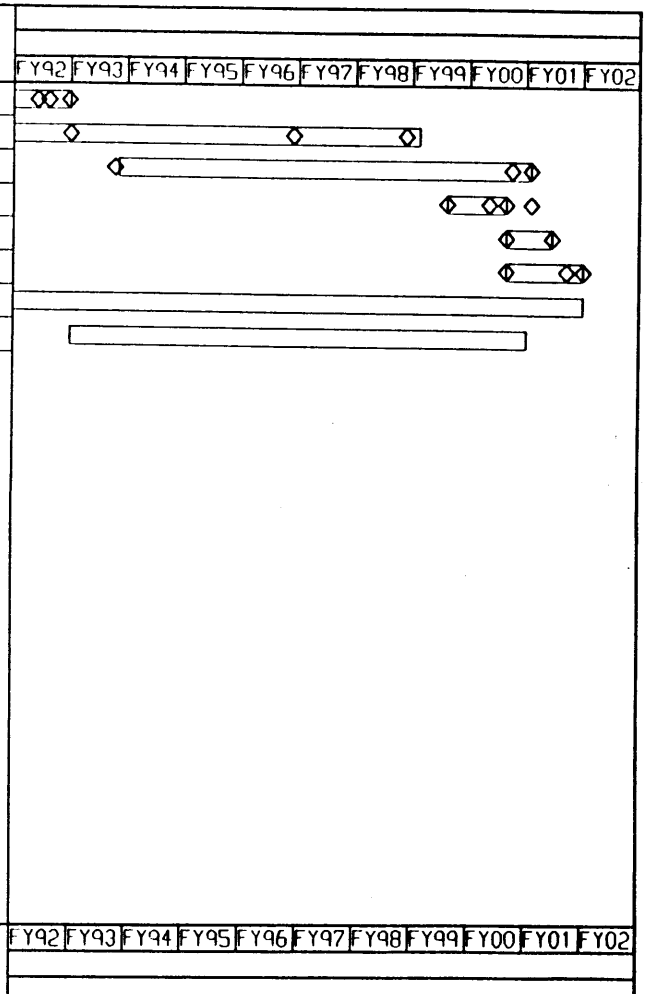
1)The Phase II scopes are estimated from available information and will be modified based on results from Phase I investigations.
2)Sample numbers are minimum values.

TABLE ES-2
BASELINE SCHEDULE AND BUDGET FOR OU 1148 RFI[1]

Activity	Schedule Start Date	Schedule Finish Date	Projected Budget Cost (in Thousands of Dollars)
RFI Work Plan	1 Oct 91	30 Sep 92	$ 1,108
RFI	1 Oct 91	13 Nov 98	45,811
RFI Report	15 Jul 93	30 Oct 00	1,816
CMS Plan	7 May 99	30 Oct 00	79
CMS	24 May 00	15 Mar 01	1,168
CMS Report	24 May 00	28 Sep 01	303
ADS Management	1 Oct 91	28 Sep 01	1,863
VCA	1 Oct 92	29 Sep 00	3,340
Subtotal			55,488
Undistributed Escalation (98-02)			1,420
Prior Years			1,736
TOTAL at Completion			58,644

[1]Baseline schedule and budget generated by Management Information System (MIS), EM-13. Baseline data is 3/16/92.

WBS4	LANL WBS 4	ORIG DUR	EARLY START	EARLY FINISH
1	ASSESSMENT - RFI WORK PLAN	250	10CT91	30SEP92
2	ASSESSMENT - RFI	1773	10CT91	13NOV98
3	ASSESSMENT - RFI REPORT	1817	15JUL93	30OCT00
4	ASSESSMENT - CMS PLAN	371	7MAY99	30OCT00
5	ASSESSMENT - CMS	200	24MAY00	15MAR01
6	ASSESSMENT - CMS REPORT	338	24MAY00	28SEP01
7	ASSESSMENT - ADS MANAGEMENT	2489	10CT91	28SEP01
8	ASSESSMENT - VCA	1991	10CT92	29SEP00



Plot Date 6MAY92
Data Date 10CT91
Project Start 10CT91
Project Finish 30SEP02

(c) Primavera Systems, Inc

Summary Bar/Early Dates
Critical Designator
Progress Bar
◇/P Milestone/Flag Activity

LANL EM-13 B GILKESON
1148: TA-51 54 R1 TBS 3/16/92
SUMMARY BAR CHART

Sheet 1 of 1

ENVIRONMENTAL RESTORATION

Date	Revision	Checked	Approved

Figure ES-4 Summary of schedule for OU 1148 RCRA Facility Investigation.

public. The Reading Room is open to the public from 9 a.m. to 4 p.m. on Laboratory business days.

4.0 Technical Memoranda/Work Plan Modifications

Because of the time required to complete the field work, interim reports will be generated and submitted as appropriate portions of the OU 1148 RFI are completed. These technical memoranda will serve both as partial RFI Phase I reports that summarize results to date and as the basis for partial Phase II work plans for any follow-up activities that might be required (including revisions of initial field sampling plans). These technical memoranda/work plan modifications will be submitted for work conducted on both individual SWMUs and aggregates of SWMUs.

REFERENCES

EPA (U.S. 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 1990. "Installation Work Plan for Environmental Restoration," Los Alamos National Laboratory Report LA-UR-90-3825, Los Alamos, New Mexico. **(LANL 1990, 0144)**

LANL (Los Alamos National Laboratory), November 1990. "Solid Waste Management Units Report," volumes I through IV, Los Alamos National Laboratory Report No. LA-UR-90-3400, prepared by International Technology Corporation under contract 9-X58-0062R-1, Los Alamos, New Mexico. **LANL 1990, 0145)**

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ABBREVIATIONS AND ACRONYMS

AA	Atomic Absorption
AA/ICP	Atomic Absorption/Inductively Coupled Plasma
ACGIH	American Congress of Governmental Industrial Hygienists
ADM	Action description memorandum
ADS	Activity data sheet
AEA	Atomic Energy Act
AEC	US Atomic Energy Commission
ALARA	As low as reasonably achievable
ANSI	American National Standards Institute
AOC	Areas of concern
AP	Administrative procedure
APR	Air purifying respirator
AR	Administrative Requirement
ARAR	Applicable or relevant and appropriate requirement
ASA	American Society of Agronomy, Inc.
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing Materials
A-E	Architect-engineer
BNA	Base/neutral/acid
CAA	Clean Air Act
CARD	Citizens Against Radioactive Dumping
CAS	Chemical Abstract Service number
CEARP	Comprehensive Environmental Assessment and Response Program
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CGI	Combustible gas indicator
CLP	Contract Laboratory Program
CLS	Chemical and Laser Sciences (Division)
CMI	Corrective measures implementation
CMS	Corrective measures study
COC	Constituent of Concern
COE	Corps of Engineers
CPR	Cardiopulmonary resuscitation
CRM	Communications and Records Management (Division)
CRPP	Community relations program plan
CRZ	Contamination reduction zone
CSCS	Cost and schedule control systems
CWA	Clean Water Act
CY	Calendar year
DCG	DOE-derived concentration guide
DEAR	Department of Energy acquisition regulation
D&D	Decontamination and decommissioning
DoD	US Department of Defense
DOE	US Department of Energy
DOE/AL	US Department of Energy/Albuquerque Operations Office
DOE/HQ	US Department of Energy/Headquarters

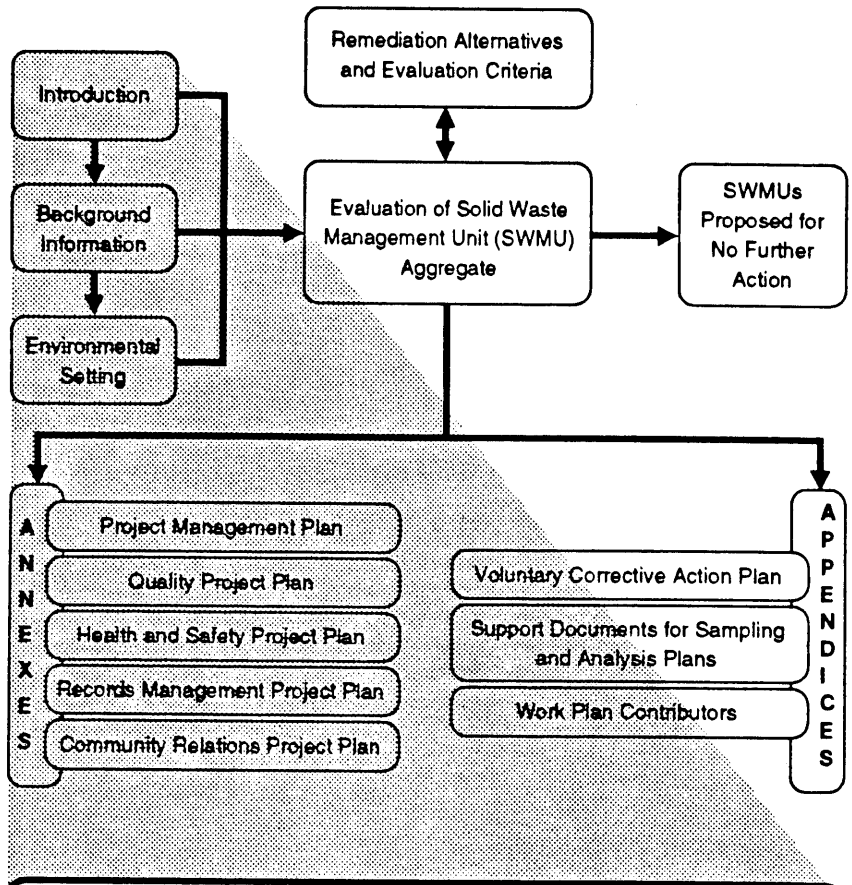
DOE/LAAO	US Department of Energy/Los Alamos Area Office
DOT	Department of Transportation
DQO	Data quality objectives
EA	Environmental assessment
ECD	Electron capture detector
EES	Earth and Environmental Sciences (Division)
EETF	Experimental Engineering Test Facility
EIS	Environmental impact statement
EM	Environmental management
ENG	Facilities Engineering (Division)
EO	Executive order
EPA	US Environmental Protection Agency
ER	Environmental restoration
ERA	Environmental Research Applications
ERDA	US Energy Research and Development Administration
ERPG	Emergency response planning guideline
ESA	Endangered Species Act
ES&H	Environment, safety, and health
FAR	Federal acquisition regulation
FID	Flame ionization detector
FIMAD	Facility for Information Management, Analysis, and Display
FS	Feasibility study
FTL	Field Team Leader
FUSRAP	Formerly Utilized Sites Remedial Action Program
FWS	Fish and Wildlife Service
FY	Fiscal year
GC	Gas Chromatograph
GC/MS	Gas chromatography/mass spectrometer
GDMS	Glow discharge mass spectrometry
GFAA	Graphite Furnace Atomic Absorption
GIS	Geographical Information System
GM	Geiger-Mueller
HPLC	High Pressure Liquid Chromatography
HRS	Hazard Ranking System
H&S	Health and safety
H&SPL	Health and Safety Project Leader
H&SPP	Health and safety program plan
HSE	Health, Safety, and Environment (Division)_
HSWA	Hazardous and Solid Waste Amendments
HTO	Tritiated water
ICP	Inductively Coupled Plasma
ICPMS	Inductively coupled plasma mass spectroscopy
IDLH	Immediately dangerous to life and health
IIRM	Institutional interim remedial measures
INAA	Instrumental neutron activation analysis
INC	Isotope and Nuclear Chemistry (Division)
IRM	Interim remedial measure
IS	Information Services (Division)
IWP	Installation work plan
LAAO	Los Alamos Area Office (a branch of the Department of Energy)
LAMPF	Los Alamos Meson Physics Facility

LAMPRE	Los Alamos Molten Plutonium Reactor Experiment
LANL	Los Alamos National Laboratory
LASL	Los Alamos Scientific Laboratory (LANL before 1979)
LDR	Land disposal Restrictions
LEL	Lower explosive limit
LIBS	Laser-induced breakdown spectroscopy
LLW	Low-level waste
LOC	Level of concern
LOQ	Limit of quantification
MAP	Mixed activation product
MCL	Maximum contaminant level
MDA	Material disposal area
MDL	Method detection limit
MEGAS	Multienergy Gamma Assay System
MFP	Mixed fission product
MOS	Mixed oxide semiconductors
MRI	Midwest Research Institute
MS	Mass Spectrometer
MSDS	Material Safety Data Sheet
MSHA	Mine Safety and Health Administration
NAAQ	National Ambient Air Quality
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NESHAP	National emission standards for hazardous air pollutants
NFA	No further action
NHPA	National Historic Preservation Act
NIOSH	National Institute of Occupational Health and Safety
NIST	National Institute of Standard and Technology
NMED	New Mexico Environment Department
NMESA	New Mexico Endangered Species Act
NMHWMR	New Mexico Hazardous Waste Management regulations
NMODC	New Mexico Oil Conservation District
NPDES	National pollutant discharge elimination system
NPL	National Priorities List
NQA	Nuclear Quality Assurance
NRC	US Nuclear Regulatory Commission
NTIS	National Technical Information Service
NWI	National Wetlands Inventory
OSCG	On-scene control group
OS&H	Occupational safety and health
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
OU	Operable unit
OUPL	Operable unit project leader
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PA/SI	Preliminary assessment/site investigation
PCB	Polychlorinated biphenyl
PEL	Permissible exposure limit
PID	Photoionization detector
PL	Project leader

PM	Program manager (ER)
PMP	Program management plan
PPE	Personal protective equipment
PQL	Practical Quantitation Limit
QA	Quality assurance
QAP	Quality assurance plan
QAPjP	Quality assurance project plan
QA/QC	Quality assurance/quality control
QC	Quality control
QP	Quality procedure
QPP	Quality program plan
QPPL	Quality program project leader
RA	Remedial action
R&D	Research and development
RD	Remedial design
RCRA	Resource Conservation and Recovery Act
RFA	RCRA facility assessment
RFI	RCRA facility investigation
RFP	Request for proposal
RI	Remedial investigation
RM	Records management
RMP	Records management plan
RMPP	Records management program plan
ROC	Radionuclide of Concern
ROD	Record of decision
RPD	Relative Percent Difference
RPF	Records-Processing Facility
RQ	Reportable quantities
SAP	Sampling and Analysis Plan
SART	Site assessment and remediation technology
SCF	Sample Coordination Facility
SCS	Soil Conservation Service
SDWA	Safe Drinking Water Act
SEN	Secretary of Energy notice
SOP	Standard operating procedure
SOW	Statement of Work
SSSA	Soil Science Society of America, Inc.
STEL	Short-time exposure limit
SVOC	Semivolatile organic compound
SW	Solid waste
SWMU	Solid waste management unit
TA	Technical Area
TBD	To be determined
TCA	Trichloroethane
TCE	Trichloroethylene
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total dissolves solids
TIC	Tentatively identified compound
TLD	Thermoluminescent dosimeter
TLV	Threshold limit value
TRU	Transuranic (waste)

TSCA	Toxic Substances Control Act
TSD	Treatment, storage, disposal
TSP	Total suspended particulates
TTL	Technical team leader
TWA	Time-weighted average
UC	University of California
UCLA	University of California, Los Angeles
USATHAMAU	Army Toxic and Hazardous Materials Agency
USC	United States Code
USGS	US Geological Survey
UST	Underground storage tank
USTR	Underground storage tank regulations
VCA	Voluntary corrective action
VCAP	Voluntary corrective action plan
VOA	Volatile organic analysis
VOC	Volatile organic compound
WBS	Work breakdown structure
WIPP	Waste Isolation Pilot Plant
WM	Waste management
WQA	Water Quality Act
XRF	X-ray fluorescence

CHAPTER 1



Introduction

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- HSWA Requirements
- NMED Closure Plan Requirements
- Description of OU and SWMUs
- Technical Approach
- Organization of Work Plan

1.0 INTRODUCTION

In March 1987, The Department of Energy (DOE) established an Environmental Restoration (ER) Program to manage compliance with environmental cleanup requirements at all of its facilities nationwide, of which Los Alamos National Laboratory is one.

This document is a site characterization work plan for assessing the nature and extent of any contamination associated with hazardous and radioactive waste sites within Operable Unit 1148 at Los Alamos National Laboratory (the Laboratory). Operable Unit 1148 (OU 1148) is comprised of Technical Areas (TAs) 54 and 51 and is located in Los Alamos County in north-central New Mexico (Figure 1.0-1). The entire OU is within the boundaries of the Laboratory, and all OU 1148 land is under DOE control. Figure 1.0-2 shows the geographic boundaries of the two TAs that comprise OU 1148. This document serves as a work plan for compliance with the Resource, Conservation, and Recovery Act (RCRA) Facility Investigation (RFI) for releases of hazardous waste and constituents from solid waste management units (SWMUs) and areas of concern (AOCs) at TAs 51 and 54. An RFI for these TAs was mandated by the Environmental Protection Agency (EPA) in Module VIII of the Laboratory's RCRA permit, which became effective February 19, 1990 (EPA 1990, 0306). As shown in Figure 1.0-3, TA-54 contains four of the Laboratory's material disposal areas (MDAs) operated by the Laboratory. The figure also shows the locations of other facilities in TA-54 and TA-51 that contain SWMUs or AOCs.

This document also serves as a closure plan modification for those units within TAs 51 and 54 that were operated under interim status but are no longer active (e.g., units that last received hazardous waste between November 19, 1980, the effective date of the hazardous waste management regulations, and February 19, 1990, when the Laboratory received its RCRA permit). This document further serves as a closure plan modification for permitted (or soon to be permitted) hazardous or mixed waste management units that are still active, but are expected to close before the year 2000 (Section 1.2). The State of New Mexico Environment Department (NMED) has authority over closure activities.

1.1 Overview of Environmental Restoration Program

The Laboratory's RCRA operating permit sets forth requirements to be implemented by the Laboratory's ER Program. In particular, the Hazardous and Solid Waste Act Amendments (HSWA) Module and the permit issued by the EPA give specific requirements and schedules for the conduct of the ER Program. The HSWA Module became effective on May 23, 1990 (EPA 1990, 0306).

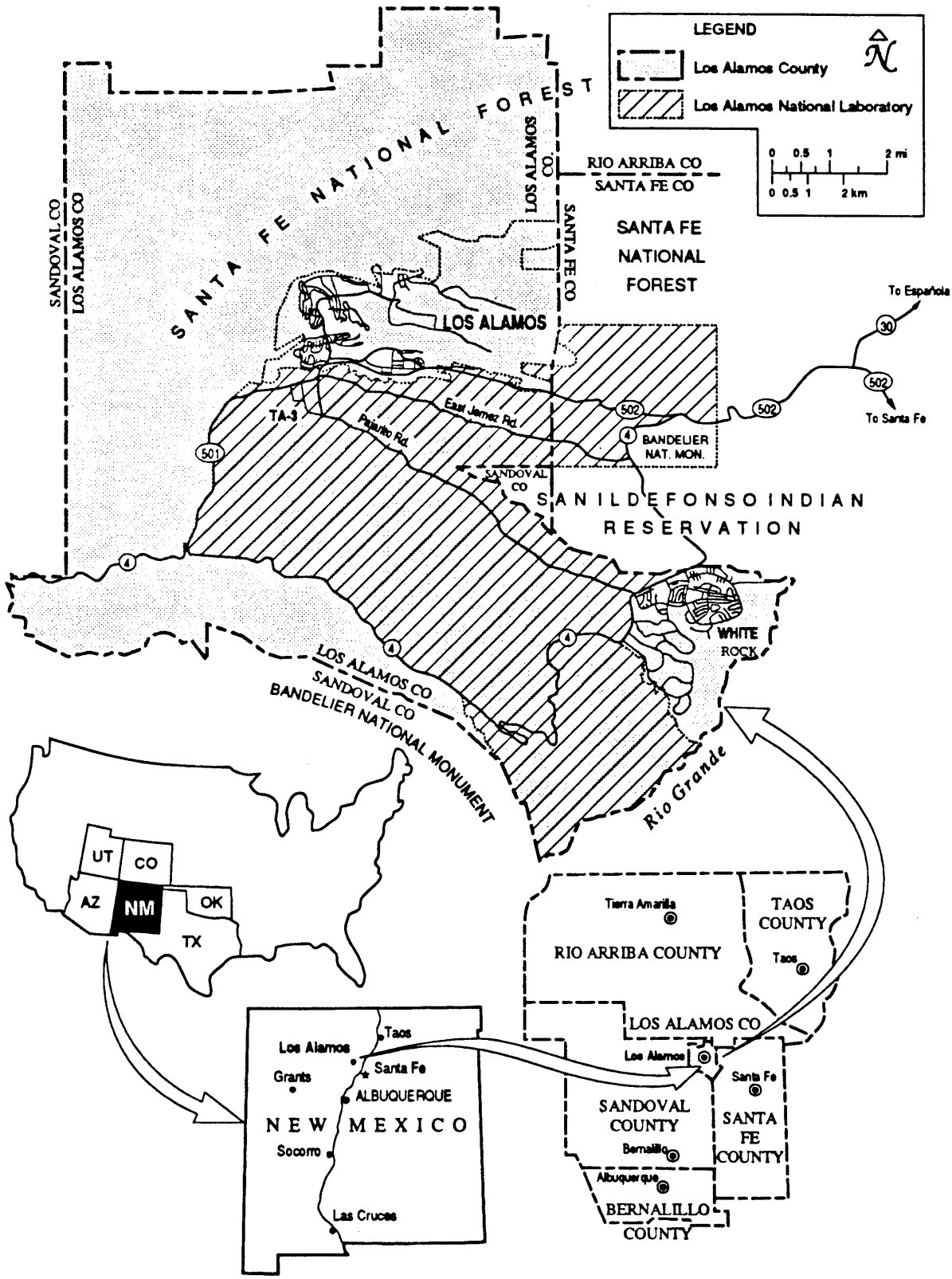


Figure 1.0-1 Location of Los Alamos National Laboratory.

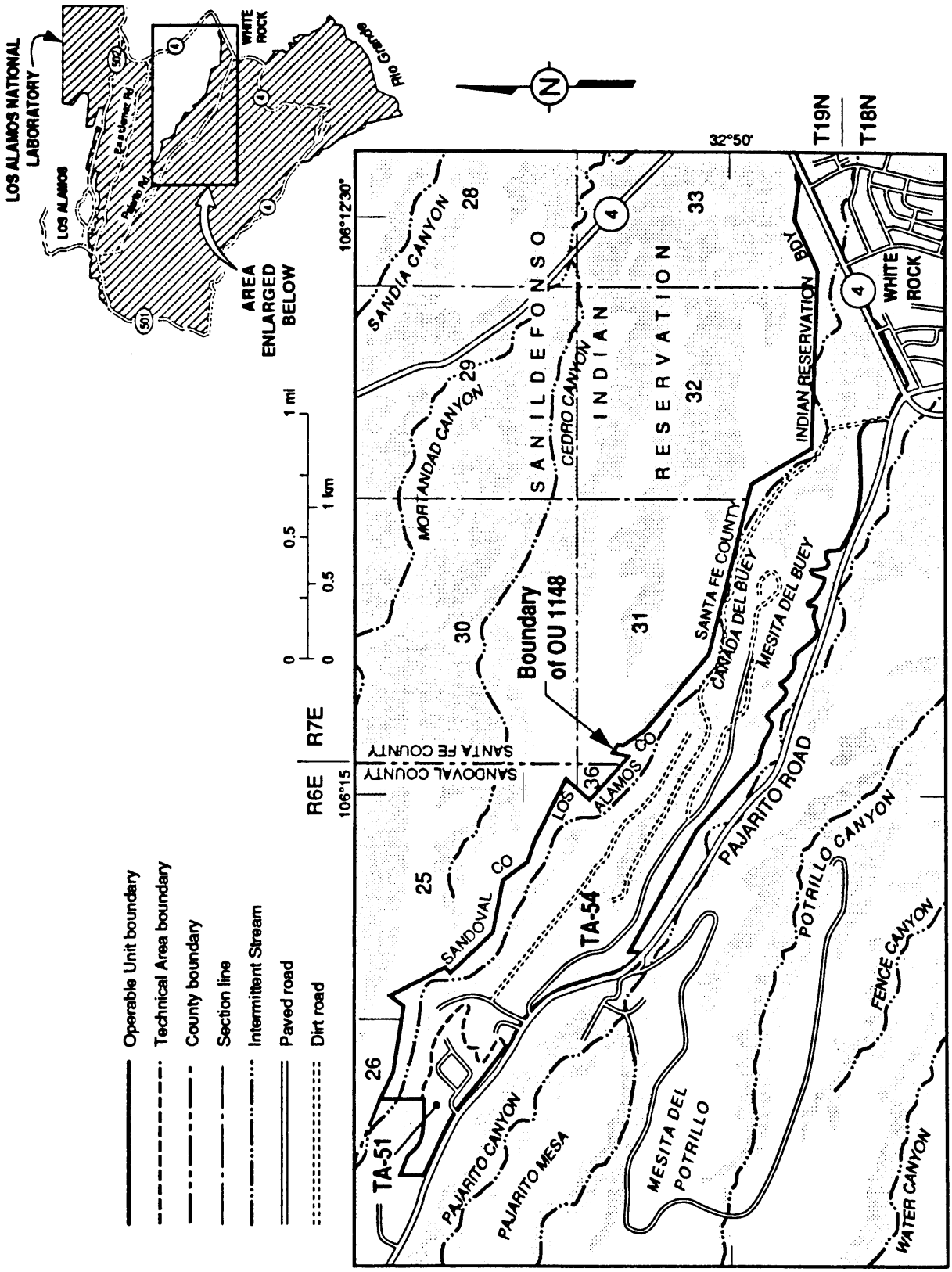


Figure 1.0-2 Location of TA-51 and TA-54.

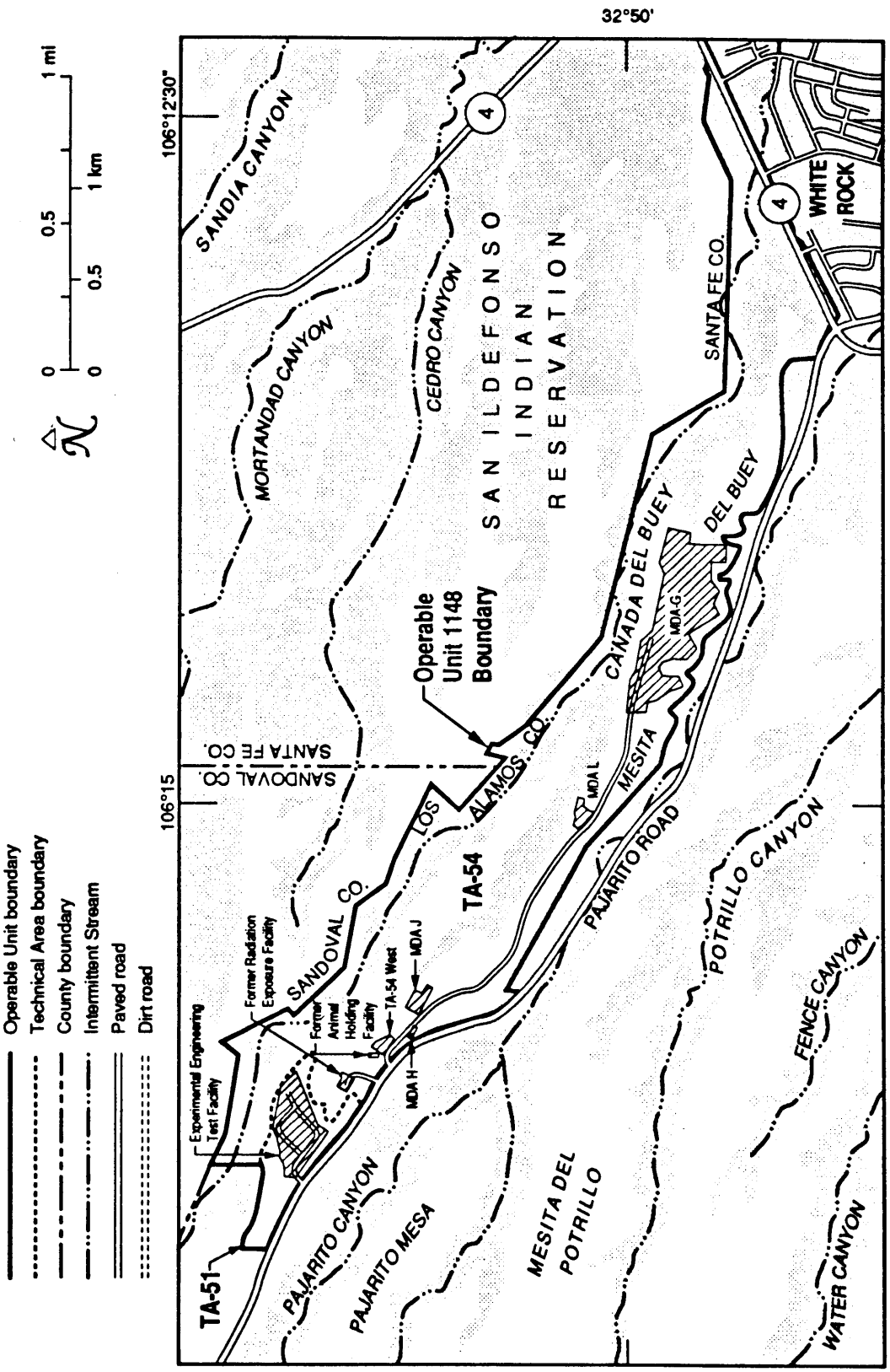


Figure 1.0-3 Location of MDAs and geographic areas in OU 1148.

1.2 Regulatory Requirements

1.2.1 Hazardous and Solid Waste Amendments

The OU 1148 RFI Work Plan addresses the HSWA Module requirements for specific investigations at TAs 51 and 54. The OU 1148 Work Plan is one of 24 OU work plans that will be prepared. The purpose of this work plan is twofold: first, to satisfy the regulatory requirements of the HSWA Module and second, to serve as the field sampling plan for personnel who will implement the RFI characterization activities detailed herein.

The HSWA Module identified 603 SWMUs at the Laboratory that require investigation (listed in Table A of the permit). In addition, the HSWA Module identified 182 of the SWMUs listed in Table A as "priority" SWMUs. The "priority" SWMUs are listed in Table B of the permit.

Tables A and B of the HSWA Module were developed by the EPA based on a SWMU Report prepared in 1988 (IT Corporation 1988, 0329). Subsequent research and investigative efforts resulted in a revised SWMU Report submitted to EPA in November 1990 (LANL 1990, 0145). The 1990 report lists over 2,200 SWMUs and AOCs at the Laboratory. As discussed in greater detail in Section 3.4.2 of the IWP (LANL 1991, 0553), no sites were eliminated in the revisions leading to the 1990 SWMU report (LANL 1990, 0145), but some SWMUs were reorganized and assigned new SWMU numbers.

The IWP grouped all of the identified SWMUs into 23 operable units that will undergo the corrective action process. Table 1.2-1 lists the SWMUs in OU 1148 that are listed in Tables A and B of the permit and the SWMUs and AOCs in OU 1148 that are included in the 1990 SWMU report (LANL 1990, 0145). This OU work plan contributes to meeting cumulative totals of addressing 40% of Table A SWMUs and 35% of Table B SWMUs, thereby meeting May 1992 HSWA Module. This work plan also presents a strategy to address all SWMUs and AOCs listed in Table 1.2-1. Figure 1.2-1 shows the locations of SWMUs and AOCs by MDA or facility.

Section 3.5 of the IWP states that each OU work plan may propose a HSWA Module Class III permit modification to adjust the SWMUs listed in Table A of the HSWA Module. Such adjustments may be necessary to remove SWMUs and AOCs determined to need no further investigation, and to add new SWMUs to the revised SWMU Report. A list of SWMUs and AOCs recommended for no further action (NFA) are given in Table 1.2-2. A brief description of SWMUs recommended for NFA is given in Table 1.2-2. The decision process which defined requirements for a recommendation of NFA is described in Section 1.4. Chapter 6 presents background information on SWMUs recommended for NFA.

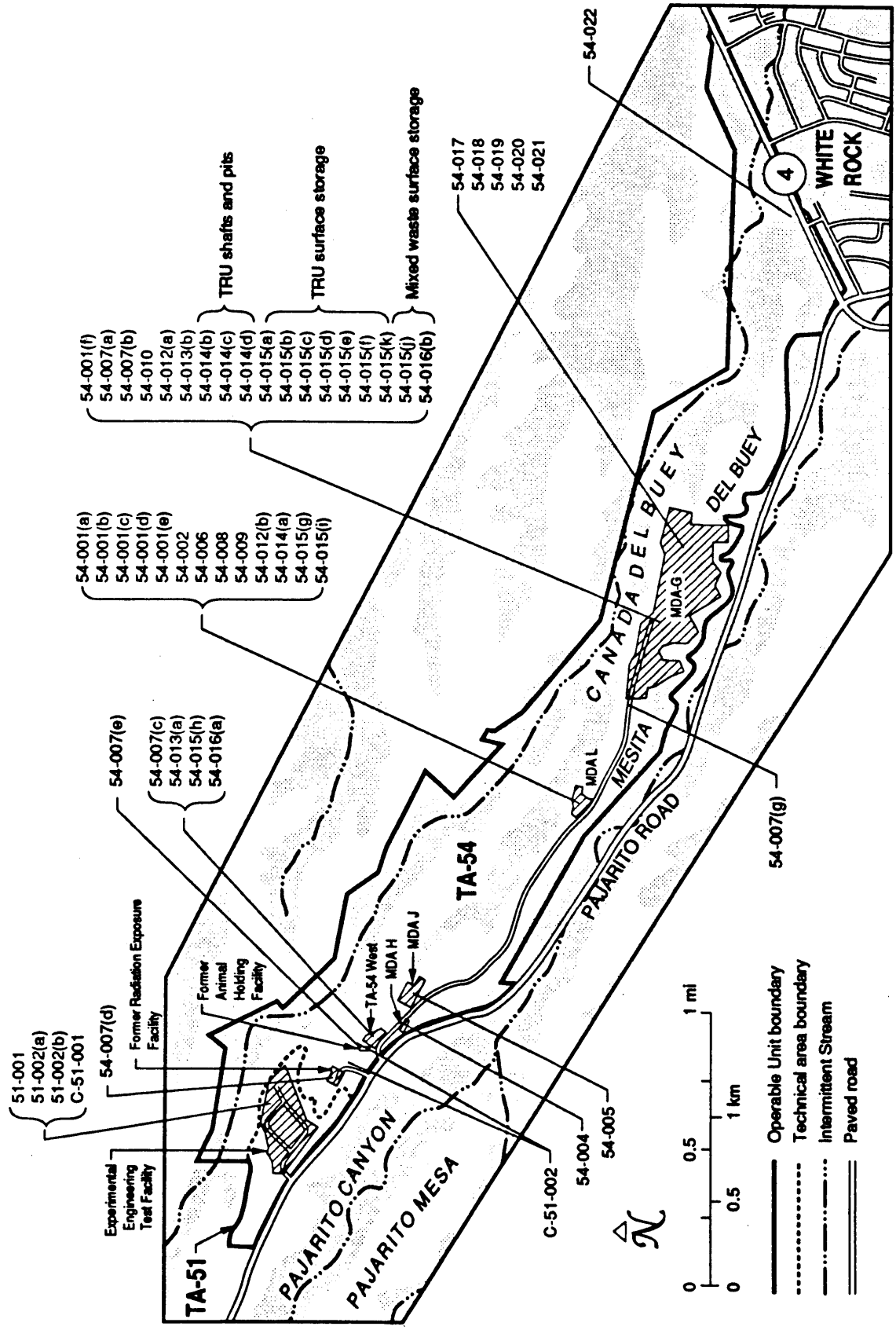


Figure 1.2-1 Locations of SWMUs and AOCs in OU 1148.

TABLE 1.2-1
SWMUs AND AOCs LISTED IN OU 1148

SWMUs Listed in HSWA Module[1]		SWMUs and AOCs Listed in 1990 SWMU Report[2]	Location of SWMUs and AOCs in OU
Table A	**Table B**		
		51-001	TA-51
		51-002(a)	TA-51
		51-002(b)	TA-51
54-001(a)		54-001(a)	TA-54, MDA L
		54-001(b)	TA-54, MDA L
54-001(c)		54-001(c)	TA-54, MDA L
		54-001(d)	TA-54, MDA L
		54-001(e)	TA-54, MDA L
		54-001(f)	TA-54, MDA G
		54-002	TA-54, MDA L
54-003(b)	54-003(b)	54-015(h)	TA-54, Western Part
54-004	54-004	54-004	TA-54, MDA H
54-005	54-005	54-005	TA-54, MDA J
54-006		54-006	TA-54, MDA L
54-007(a)		54-007(a)	TA-54, MDA G
54-007(b)		54-007(b)	TA-54, MDA G
54-007(c)		54-007(c)	TA-54, Western Part
		54-007(d)	TA-54, Western Part
		54-007(e)	TA-54, Western Part
		54-008	TA-54, MDA L
		54-009	TA-54, MDA L
		54-010	TA-54, MDA G
		54-012(a)	TA-54, MDA G
		54-012(b)	TA-54, MDA L
54-013		54-013(a)	TA-54, Western Part
		54-013(b)	TA-54, MDA G
		54-014(a)	TA-54, MDA L
		54-014(b)	TA-54, MDA G
		54-014(c)	TA-54, MDA G
		54-014(d)	TA-54, MDA G
		54-015(a)	TA-54, MDA G
		54-015(b)	TA-54, MDA G
		54-015(c)	TA-54, MDA G
		54-015(d)	TA-54, MDA G

TABLE 1.2-1, Continued
SWMUs AND AOCs LISTED IN OU 1148

SWMUs Listed in HSWA Module[1]		SWMUs and AOCs Listed in 1990 SWMU Report[2]	Location of SWMUs and AOCs in OU
Table A	Table B		
		54-015(e)	TA-54, MDA G
		54-015(f)	TA-54, MDA G
		54-015(g)	TA-54, MDA L
		54-015(i)	TA-54, MDA L
		54-015(j)	TA-54, MDA G
		54-015(k)	TA-54, MDA G
		54-016(a)	TA-54, Western Part
		54-016(b)	TA-54, MDA G
		54-017	TA-54, MDA G
		54-018	TA-54, MDA G
		54-019	TA-54, MDA G
		54-020	TA-54, MDA G
		54-021	TA-54, MDA G
		54-022	TA-54, MDA G
		AOCs	
		C-51-001	TA-51
		C-51-002	TA-54 (Western Part)
		C-54-001[3]	TA-54 (Western Part)

[1]EPA (U.S. 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 1990, 0306)

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

[3]AOC C-54-001 is also listed as SWMU 54-016(a) and is addressed in this work plan under the SWMU listing.

TABLE 1.2-2
SWMUs AND AOCs IN OU 1148 RECOMMENDED FOR NFA

SWMUs Listed in HSWA Module[1]	SWMUs and AOCs Listed in 1990 SWMU Report[2]
	SWMUs
	51-002(a)
	51-002(b)
54-001(c)	54-001(c)
	54-001(f)
54-003(b)	54-015(h)
	54-008
	54-010
54-013	54-013(a)
	54-015(g)
	54-015(i)
	54-016(a)
	54-021
	54-022
	AOCs
	C-51-001
	C-51-002
	C-54-001[3]

[1]EPA (U.S. 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 1990, 0306)

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

[3]AOC C-54-001 is also listed as SWMU 54-016(a) and is addressed in this work plan under the SWMU listing.

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

Several SWMUs listed in the HSWA Module for OU 1148 are subject to both the corrective action and closure provisions of RCRA (e.g., RCRA hazardous wastes were intentionally managed at these sites after November 19, 1980). The DOE will manage these sites in a manner consistent with the management of all of the other SWMUs in the Operable Unit listed in the Laboratory's SWMU data base. As a result, the corrective action process will occur concurrently with the closure process, thereby satisfying both sets of regulations. It is understood that the NMED will maintain its role as the lead regulatory agency for these sites.

DOE/UC will implement this strategy for several reasons: (1) The RFI/CMS portions of the corrective action process ensure that releases are identified and mitigated as part of a final remedy whereas compliance with closure standards does not always guarantee mitigation; (2) This strategy allows for a consistent, coherent approach to environmental restoration (e.g., some SWMUs in the OU are subject only to RCRA corrective action while other SWMUs are subject to both corrective action and closure); (3) This strategy prevents duplication of effort; and (4) This strategy is consistent with the preamble to proposed Subpart S, which states EPA's intent to allow extension of closure deadlines as necessary to complete corrective actions. The final remedy for these sites will be consistent with closure performance standards, and postclosure monitoring will continue if the waste remaining in these sites releases concentrations of contaminants that exceed closure standards.

Several discrete pits, trenches, and shafts within material disposal areas (MDAs) L, H, and G at TA-54 received hazardous waste after November 19, 1980, the effective date of the RCRA hazardous waste regulations (see Table 1.2-3). Consequently, they are subject to the RCRA interim status treatment, storage, and disposal regulations, which include provisions governing their closure. Since the Laboratory made a decision to discontinue use of these units prior to receiving a permit, the interim status closure process applies. Because authority to enforce these RCRA closure provisions has been delegated to the NMED, and because enforcement authority for the RCRA corrective action requirements for SWMUs remains with EPA, NMED intends to request that EPA remove these sites from the list of SWMUs in the Laboratory RCRA Permit that must be taken through the corrective action process. The purpose of the State request is to eliminate dual authority over a subset of disposal units within TA-54, and to guarantee that NMED remains the lead regulatory agency for sites subject to the delegated closure provisions of RCRA. However, the result of this request will be that closure of individual pits, shafts, and trenches located adjacent to each other (less than 10 ft away in some cases) will be under the authority of two different regulatory agencies that may impose different technical requirements according to inconsistent schedules. Since September of 1990, the Laboratory has cooperated with NMED and EPA to ensure that the cleanup approach taken within TA-54 is integrated, consistent, and sensible, despite overlapping authorities.

As mentioned in Section 1.0, this document is considered a closure plan *modification*, rather than an initial submittal. This is because the Laboratory has already submitted closure plans for the hazardous waste management units (in **boldface**)

identified in Table 1.2-3 as subject to closure under interim status. The closure plan for the interim status units within MDA G was first submitted in September 1985, and the closure plan for units within MDAs H and L was submitted in November 1986. These early closure plans were submitted to satisfy a RCRA compliance deadline, and are deficient to achieve the goals of the current ER Program. Thus, this document serves to modify the old closure plans by providing a work plan for site characterization and a schedule for completion of closure activities which will be based on the results of the field investigation.

Similar to the interim status units, there are several hazardous and mixed waste management units within MDAs L and G that are still operating and either hold a current permit, or the permit is in the process of being approved (Table 1.2-3, *italicized*). Since the Laboratory waste management group (EM-7) plans to consolidate and move the permitted surface storage and treatment SWMUs at MDA L within five years, these SWMUs (*italicized and underlined* in Table 1.2-3) will become subject to RCRA closure under permitted status within a time frame amenable to the ER Program. Thus, this document also serves as a closure plan modification for permitted units that will cease operations before the year 2000, when the ER Program is expected to begin implementing corrective measures. Original closure plans for these units were submitted with the two RCRA Part B Permit applications (hazardous and mixed waste). Table 1.2-4 presents a list of ER Program documentation which will be prepared in accordance with the RCRA corrective action process, and will simultaneously serve as closure plan modifications.

When appropriate, the Corrective Measures Design Report will also serve as a post-closure care plan. A Corrective Measures Verification Report which will document the effectiveness of the various corrective actions will also be submitted. This final report will serve as a closure report/certification, and as a status report on the post-closure monitoring program for units where waste will remain in place. Additional periodic reports concerning post-closure care are likely to be required by the NMED.

The NMED uses a checklist to evaluate the adequacy of closure plans prepared in the State of New Mexico. To assist their auditors, Table 1.2-5 lists the State's minimum requirements for closure plans, indicates in which section(s) of this work plan they are satisfied, or alternatively discusses why the element can not be found in this closure plan modification, and where to find it now or in the future.

1.2.3 CERCLA, DOE Order 5820.2A, NEPA, and Other Laws and Orders

1.2.3.1 CERCLA

The Environmental Restoration work at the Laboratory is performed in compliance with a RCRA Facility Permit. However, this work is also performed in accordance with applicable sections of CERCLA, as required by DOE Order 5400.4 (DOE 1989, 0078). CERCLA Section 120 extends natural resource damage liability to federal facilities. The first part of the natural resource damage assessment is a preassessment screen governed by regulations in Code of Federal Regulations Title 43 (43 CFR) Part II. The preassessment screen will be used to determine whether a complete

TABLE 1.2-3
ORGANIZATION OF SWMUs AND AOCs BY REGULATORY REQUIREMENTS[1]

Geographic Area	HSWA Module SWMUs[2]	Database SWMUs and AOCs[3]	Potential Release Sites	Operational Status
Material Disposal Area (MDA) J				
SWMUs with sampling plans in this work plan (Section 5.1)	Three Pits at MDA J (54-005)[4]		4 Disposal Pits, 2 new Pits, and 2 Disposal Shafts	3 disposal pits are inactive and covered; 1 disposal pit is active; the 2 new pits will be used in the future. 1 disposal shaft is inactive and scheduled to be sealed in FY92; 1 disposal shaft is active.
Material Disposal Area (MDA) H				
SWMUs with sampling plans in this work plan (Section 5.2)	Shafts 1-8 at MDA H (54-004)[4]	Shafts 1-8 and Shaft 9 at MDA H (54-004)	8 Disposal Shafts operated prior to 11/19/80, 1 Disposal Shaft operated after 11/19/80	Inactive
Material Disposal Area (MDA) L				
SWMUs with sampling plans in this work plan (Section 5.3)	Material Disposal Area L (54-006)[4]	Material Disposal Area L (54-006) Pit A, Surface impoundments B, C, and D, Disposal shafts 1, 14-34, and Disposal shafts 2-13.	12 Disposal Shafts operated prior to 11/19/80, 22 Disposal Shafts operated after 11/19/80, 3 Surface Impoundments, and 1 Pit	Inactive
		PCB Storage Building [54-001(d)]	1 Storage Building	All active surface treatment and storage units at Area L will be relocated to TA-63 by approximately 1996.
	Bermed Hazardous Waste Storage Area for Pails and Drums [54-001(a)]	*Bermed Hazardous Waste Storage Area for Pails and Drums [54-001(a)]*	*1 Storage Area*	*All active surface treatment and storage units at Area L will be relocated to TA-63 by approximately 1996.*
		Container Accumulation, Packaging, and Storage Area at TA-54-31 [54-001(b)]	*1 Storage Area*	*All active surface treatment and storage units at Area L will be relocated to TA-63 by approximately 1996.*
		Sheltered, Six-celled Concrete Storage Pad, TA-54-32 [54-001(e)]	*1 Storage Pad*	*All active surface treatment and storage units at Area L will be relocated to TA-63 by approximately 1996.*

TABLE 1.2-3, (CONTINUED)
ORGANIZATION OF SWMUs AND AOCs BY REGULATORY REQUIREMENTS[1]

Geographic Area	HSWA Module SWMUs[2]	Database SWMUs and AOCs[3]	Potential Release Sites	Operational Status
		Compressed Gas Storage Area (54-002)	*1 Storage Area*	*All active surface treatment and storage units at Area L will be relocated to TA-63 by approximately 1996.*
		Treatment Tanks (54-009)	*4 Treatment Tanks*	*All active surface treatment and storage units at Area L will be relocated to TA-63 by approximately 1996.*
		Drum Compactor [54-012(b)]	1 Compactor	All active surface treatment and storage units at Area L will be relocated to TA-63 by approximately 1996.
		Radioactive Waste Storage Shafts and Pits, Lead Stringer Shafts [54-014(a)]	*2 Storage Shafts*	*These shafts will actively store the lead stringers until they decay to the point that they can be packaged for long-term storage.*
		Former location of six waste oil storage tanks (AOC)	Contaminated soil at former location of tanks	Inactive
SWMUs Recommended for NFA (Section 6.3)	Bermed Asphalt Pad for Storage of Waste Oil and Hazardous Materials [54-009(c)]	Bermed Asphalt Pad for Storage of Waste Oil and Hazardous Materials [54-001(c)]	Former site of a portable berm that contained an open tank. The tank and berm never managed waste.	Inactive
		Sewage Tank (54-008) and 2 additional sewage tanks	1 Sewage Tank	To be used indefinitely for administrative support buildings
		Lead Casks Near Shaft 4 [54-015(g)]	1 Storage Area	Inactive
		Rad-Contaminated Forklift Battery [54-015(i)]	1 Storage Area	Inactive
Material Disposal Area (MDA) G				
SWMUs with sampling plans in this work plan (Section 5.4)	Septic System Leach Field, TA-54-16 [54-007(a)]	Septic System Leach Field, TA-54-16 [(54-007(a)]	1 1,000-gal Underground Tank and 900-sq-ft Seepage Trench	This septic system will continue to serve buildings 2 and 11 beyond 2000.
		Compactor, TA-54-2 [54-012(a)]	1 Compactor	Will be operational indefinitely (beyond 2000)

TABLE 1.2-3, (CONTINUED)
ORGANIZATION OF SWMUs AND AOCs BY REGULATORY REQUIREMENTS[1]

Geographic Area	HSWA Module SWMUs[2]	Database SWMUs and AOCs[3]	Potential Release Sites	Operational Status
		Truck Washing Pit [54-013(b)]	1 Decon Pit located within MDA G	Inactive, converted to pit 19
		Radioactive Waste Storage Pit 9 [54-014(b)]	1 Storage Pit	TRU Waste will be retrieved from this pit starting in 1999. Feasibility under review.
		Radioactive Waste Storage Shafts and Pits, TRU Shafts 200-233 [54-014(c)]	34 existing Storage Shafts	TRU Waste will be retrieved from shafts 200-233 starting in 1999; retrieval will continue for several years. Feasibility under review.
		Radioactive Waste Storage Shafts and Pits, TRU Trenches A-D [54-014(d)]	4 Storage Trenches	TRU Waste will be retrieved from these units starting in 1999, retrieval will continue for several years. Feasibility under review.
		Drum Storage Area for TRU waste [54-015(a)]	*1 Storage Area*	*Active area for holding drums of TRU waste prior to spraying drums with corrosion inhibitors.*
		Surface Storage of TRU Waste Near TA-54-11 [54-015(b)	1 Storage Area	Active
		TRU Waste Storage Pad 1 [54-015(c)]	*1 Storage Pad*	*TRU Waste will be retrieved from this unit starting in 1999; retrieval will continue for several years past 2000.*
		TRU Waste Storage Pad 2 [54-015(d)]	*1 Storage Pad*	*TRU Waste will be retrieved from this unit starting in 1999; retrieval will continue for several years past 2000.*
		TRU Waste Storage Pad 3 [54-015(e)]	*1 Storage Dome*	*WIPP-certified waste will be stored here until the new long term storage facility is operational (after 2000).*
		TRU Waste Storage Pad 4 [54-015(f)]	*1 Storage Pad*	*TRU Waste will be retrieved from this unit starting in 1999; retrieval will continue for several years past 2000.*
		Mixed Waste Dome, TA-54-49 [54-015(j)]	*1 Storage Facility*	*Low-level mixed waste storage operations will be relocated to TA-63 in 1995-1996.*

TABLE 1.2-3, (CONTINUED)
ORGANIZATION OF SWMUs AND AOCs BY REGULATORY REQUIREMENTS[1]

Geographic Area	HSWA Module SWMUs[2]	Database SWMUs and AOCs[3]	Potential Release Sites	Operational Status
		TRU Waste Mound [54-015(k)]	1 Storage Mound	TRU Waste will be retrieved from this mound starting in 1999, and retrieval operations will continue for several years. Feasibility under review.
		Sump in TA-54-33 [54-016(b)]	1 Sump	This sump will collect TRU waste drum washwater for several years past 2000.
		MDA G Disposal Pits active before 11/19/80 (54-017)	19 Disposal Pits	Inactive
		MDA G Disposal Pits active after 11/19/80 (54-018)	6 pits used prior to May 1985, 5 pits used only after May 1985 (when LANL ceased disposing hazardous wastes in MDA G)	10 pits are inactive, one pit (37) is still active, but will be filled by 2/92
		MDA G Disposal Shafts active before 11/19/80 (54-019)	91 Disposal Shafts	Inactive
		MDA G Disposal Shafts active after 11/19/80 (54-020)	37 shafts active prior to May 1985, 35 shafts active only after May 1985, 13 shafts used for PCB contaminated waste oil (C1-C13), and 8 unused shafts for retrievable TRU waste (142-149)	All disposal shafts within this SWMU, except 21-23, are capped and inactive. The waste to be stored in shafts 142-149 will be retrieved after 2000. Never stored waste to date.
		Mixed Waste Container Storage Areas, Above Pit 30[5]	1 Storage Area	To be used beyond 2000.
		Mixed Waste Container Storage Areas, Above Pit 33[5]	1 Storage Area	To be used beyond 2000.
SWMUs Recommended for NFA (Section 6.4)		Empty Drum Storage Area East of TRU Storage [54-001(f)]	1 Storage Area for empty unused drums	Will be used for storage beyond 2000. Never stored waste.
	Septic System Seepage Pit, TA-54-28 [54-007(b)]	Septic System Seepage Pit, TA-54-28 [54-007(b)]	1 Underground Tank and Seepage Pit	To be removed in FY92, this septic system is inactive.
		Underground Tank (54-010)	1 Underground Tank used for supply water	Active, never handled waste.

TABLE 1.2-3, (CONTINUED)
ORGANIZATION OF SWMUs AND AOCs BY REGULATORY REQUIREMENTS[1]

Geographic Area	HSWA Module SWMUs[2]	Database SWMUs and AOCs[3]	Potential Release Sites	Operational Status
		Waste Oil Storage Tanks (54-021)	6 Storage Tanks	Tanks have undergone RCRA closure.
		PCB Transformer Leak at TA-54-75 (54-022)	1 Spill	Inactive
TA-51/TA-54 (Western Part)				
SWMUs with sampling plans in this document (Section 5.5)				
TA-51 Experimental Engineering Test Facility		Septic System (51-001)	1 Septic System	To be taken out of service by SWSC in 1992-1993.
TA-54 (West) NDT Facility	Septic System and Evapotranspiration Bed [54-007(c)]	Septic System and Evapotranspiration Bed [54-007(c)]	1 Septic System	To be taken out of service by SWSC in 1992-1993.
TA-54 Former Radiation Exposure Facility		Septic System Leach Field TA-54-4 [54-007(d)]	1 Leach Field	To be taken out of service by SWSC in 1992-1993.
TA-54 Former Animal Holding Facility		Septic System Leach Field TA-54-9 [54-007(e)]	1 Leach Field	To be replaced by SWSC in 1992-1993.
SWMUs and AOCs Recommended for NFA (Section 6.5)				
TA-51 Experimental Engineering Test Facility		Environmental Research Site, Caisson TA-51-38 [51-002(a)]	1 Subsurface Caisson	Will remain active indefinitely, does not handle hazardous waste or constituents.
		Environmental Research Site, Caisson TA-51-39 [51-002(b)]	1 Subsurface Caisson	Constructed, but never used.
		AOC C-51-001	Drums of soil used at TA-51-38. There are no hazardous wastes, hazardous constituents or radionuclides.	Drums have been removed.

TABLE 1.2-3, (CONTINUED)
ORGANIZATION OF SWMUs AND AOCs BY REGULATORY REQUIREMENTS[1]

Geographic Area	HSWA Module SWMUs[2]	Database SWMUs and AOCs[3]	Potential Release Sites	Operational Status
TA-54 (West) NDT Facility	Truck Washing Pit (54-013)	Planned Truck Washing Pit [54-013(a)]	None	The truck washing pit was not constructed.
	Drum Storage Area in Building TA-54-38 [54-003(b)][4,6]	*Drum Storage Area in Building TA-34-38 [54-015(h)]*	*1 Drum Storage Area*	*This building will be used during retrieval of stored TRU wastes beyond the year 2000.*
		Sump in TA-54-38 [54-016(a)][7]	1 Sump	Will remain active beyond the Year 2000.
AOCs in the Western Part of TA-54		AOC-51-002	Former location of two magazine structures	Inactive and removed.

[1] Potential release sites in Bold type are subject to RCRA closure under interim status. Potential release sites that are *Italicized* are operating under permitted status and will eventually be subject to closure regulations. This work plan is a closure plan modification for potential release sites indicated by *underlined italics.*

[2] SWMUs listed in the HSWA Module (EPA 1990, 0306).

[3] SWMUs and AOCs listed in the 1990 SWMU Report (LANL 1990, 0145).

[4] This SWMU is listed as a "priority SWMU" in Table B of the HSWA Module (EPA 1990, 0306).

[5] These sites were identified during review of operational information. The sites will be evaluated in accordance with Laboratory Administrative Procedure LANL-ER-AP-04.01, Rev. 1, for a finding on inclusion in the SWMU database.

[6] SWMU No. 54-003(a) has been deleted because MDA-G is addressed in SWMU Nos. 54-014, 54-017, 54-018, and 54-019. SWMU No. 54-003(b) has been renumbered to SWMU No. 54-015(h).

[7] Also listed as AOC No. C-54-001 in Appendix C of 1990 SWMU Report (LANL 1990, 0145).

TABLE 1.2-4
RCRA CORRECTIVE ACTION PHASE DOCUMENTS

RCRA Corrective Action Phase RCRA Facility Investigation/Corrective Measures Study (RFI/CMS)	Documents Monthly Management Reports Quarterly Technical Progress Reports
Investigative Analysis Reports	RFI Work Plan RFI Technical Memoranda RFI Report
Corrective Measures Implementation (CMD/CMI)	CMS Work Plan CMS Technical Memorandum CMS Report CMI Plan Monthly Management Plan Quarterly Technical Progress Reports Correction Measures Verification Report Post-closure Monitoring Report Post-closure Measures Reports

TABLE 1.2-5
NMED CLOSURE PLAN CHECKLIST

Checklist of Minimum Requirements	Work Plan Section/Compliance Description
A description of how and when each hazardous waste management unit will be partially, then finally closed.	In most cases, the method of closure will not be specified and scheduled until the Corrective Measures Study (CMS) is completed
An up-to-date estimate of the maximum inventory of wastes in storage and treatment at any time during the active life of the facility	Each geographic area within the operable unit has a section called Existing Information which provides this information on a SWMU-by-SWMU basis
A description of the steps needed to remove or decontaminate all hazardous waste residues, contaminated system structures, equipment structures, and spills	This will be done in the CMS
A schedule for closure of each hazardous waste management unit	This will be done in the CMS.
An estimate of the expected year of closure	This will be done in the CMS.
A schedule for final closure, including time estimates for each phase of closure and a total time estimate	This will be done in the CMS.
Plan must address all areas of hazardous waste management, reflect changes in facility operations or design, and provide up-to-date cost estimates	Existing Information sections describe each hazardous or mixed waste management unit, and cost estimates are provided in Annex I

natural resource damage assessment is appropriate. The preassessment screen will be integrated with the CERCLA ecological assessment process for this operable unit. A general description of the preassessment screen and the ecological assessment will be included in the next version of the IWP. Any modifications of the general procedure that might be necessary for this operable unit will be described in future progress reports of this operable unit facility investigation. This is consistent with the Guidance for Natural Resource Trusteeship and Ecological Evaluation for Environmental Restoration at DOE Facilities, 1991 (DOE 1989, 0078).

1.2.3.2 DOE Order 5820.2A

DOE Order 5820.2A, Radioactive Waste Management, was established in 1988 (replacing its 1984 predecessor) to provide policies, guidelines, and minimum requirements for the on-going management of radioactive and mixed waste. For example, the Order mandates that the design of new disposal units achieves the following performance objectives:

- No member of the public should receive exposures greater than 25 mrem/yr due to routine operations, and the radionuclide standards in the National Emission Standards for Hazardous Air Pollutants (NESHAPs) must be complied with; and

- 100 years after the site closes, no intruder (member of the public encroaching on the site) should receive a continuous dose of greater that 100 mrem/yr, and the disposal site should be designed such that an intruder will never receive an acute (accidental, one-time) exposure greater that 500 mrem/yr. DOE Order 5820.2A mandates a "performance assessment" to prove that the radioactive waste management unit design currently in use can achieve these two performance objectives. The Environmental Protection Group (EM-8) at the Laboratory is currently engaged in a performance assessment for MDA G. However, there are specific provisions of the Order that apply to environmental restoration of inactive, radioactive, and mixed waste units that first received waste after the effective date of the Order, September 26, 1988.

1.2.3.3 NEPA Compliance

Because each ER Program phase possesses a unique potential to affect the environment, NEPA compliance associated with ER activities at TA 51/54 will be addressed by program phase.

1.2.3.4 Other Relevant Laws, Orders, and Requirements

Module VIII of the HSWA Permit establishes Corrective Action Requirements (CARs). Task IV, Investigative Analysis, specifies that the permittee must identify all relevant and applicable standards for the protection of human health and the environment. Task VI, Identification and Development of the Corrective Action

Alternative or Alternatives, further specifies that based on the results of the RFI, the permittee must identify, screen, and develop the alternatives for removal, containment, treatment, and/or remediation of contamination based on objectives established for corrective action. Cleanup requirements can be divided into three categories: (1) contaminant-specific requirements which address specific contaminants, (2) location-specific requirements which are based on a specific site setting, and (3) action-specific requirements associated with specific response actions. In the absence of more information about type and concentration of contaminants at the SWMUs being investigated, the identification of potential CARs at this time would be premature. The full tabulation of potential location-specific, contaminant-specific, and action-specific requirements will be provided in future technical reports as adequate SWMU information is obtained through the RFI process.

1.3 Description of OU 1148 and Its SWMUs

Operable Unit 1148 is comprised of two TAs (TA-51 and TA-54). The 1007-acre OU is located in Los Alamos County in north-central New Mexico (Figure 1.0-1). The entire OU is within the boundaries of the Laboratory, and all OU 1148 land is under DOE control. The boundaries of TAs 51 and 54 are shown on Figure 1.0-2. As shown in Figure 1.0-3, TA-54 contains four MDAs operated by the Laboratory. The figure also shows the locations of other facilities in the western part of TA-54 and in TA-51 that contain SWMUs or AOCs. The geographic distribution of SWMUs in the OU is used as a basis for forming SWMU aggregates.

SWMU aggregates are formed for each of the four MDAs and are discussed in separate sections of this work plan. SWMUs and AOCs located outside of MDAs are assigned to associated facilities located in the western part of TA-54 and in TA-51. The locations of the MDAs and the other facilities are shown on Figure 1.0-3. The aggregates of SWMUs and AOCs by location at MDAs and at other facilities are shown in Table 1.2-1 and Figure 1.2-1. Table 1.2-3 gives a brief description for each SWMU and AOC. Descriptions of the MDAs and the other facilities in the operable unit are given below in discussion of future land use.

1.3.1 Conceptual Model for Conditional Remedy at MDAs

The four MDAs in TA-54 will be held under institutional control by DOE with eventual transfer to Bandelier National Monument. Corrective action for the MDAs will follow the conditional remedy guidance presented in the proposed RCRA Subpart S. The criteria for implementation of a conditional remedy include

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

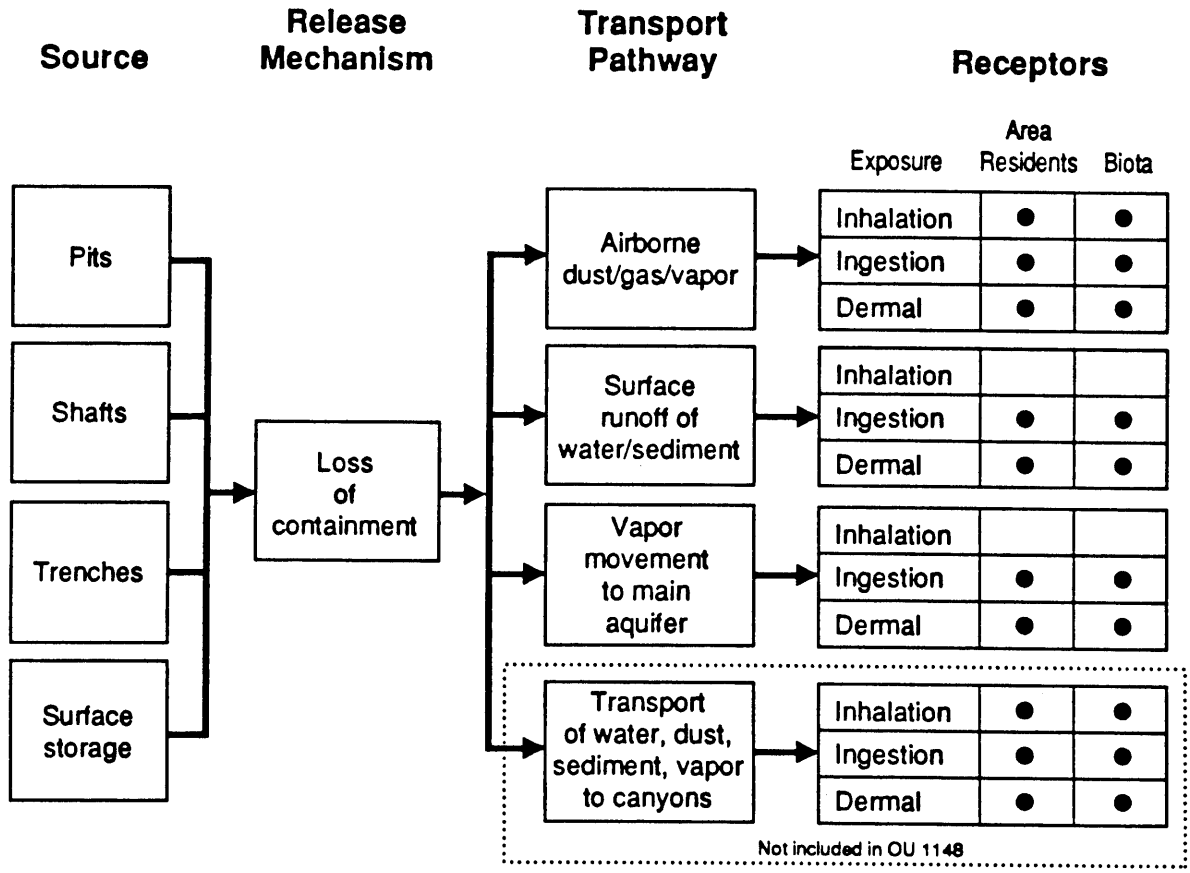


Figure 1.3-1 Conceptual model for MDAs at TA-54.

Corrective action for the MDAs will include stabilization and post-closure monitoring to insure that contaminants are not being released beyond controlled site boundaries at concentrations that exceed health risk-based standards or action levels. Remediation of release sites located within the area of institutional control will be based on conditional remedy requirements.

Figure 1.3-1 presents the conceptual model for the MDAs. The primary sources of contamination are hazardous and radioactive wastes disposed in pits, shafts, and impoundments, or held in surface storage. The primary release mechanism is loss of containment which results in migration of contaminants out of the controlled area. Animals that enter the controlled area may receive direct exposure to released contaminants. Secondary sources of contamination are gases, vapor, water, and soil. Release mechanisms include wind, surface water runoff, and transport of vapors within the vadose zone.

Using a phased approach, sampling plans in the work plan characterize the concentrations of contaminants migrating away from the MDAs in each pathway. This characterization will meet conditional remedy requirements to evaluate releases beyond the boundaries of the MDAs.

1.3.1.1 MDA J

MDA J contains three inactive pits, one active pit for nonhazardous waste disposal, one inactive shaft, and one active shaft for classified waste disposal. MDA J also contains a land farming unit for treatment of petroleum contaminated soils. There are no known releases of contaminants from MDA J. However, a Phase I investigation will be performed to confirm the absence or presence of contamination. The location of MDA J is shown in Figure 1.0-3. Background information on the MDA and the sampling plan is presented in Section 5.1.

1.3.1.2 MDA H

MDA H consists of nine disposal shafts (shaft number nine is subject to RCRA closure regulations). The MDA was designated for permanent disposal of uncontaminated classified wastes. However, tritium is known to have been disposed of in the shafts, and materials contaminated with high explosives and radionuclides were disposed of as well. The location of MDA H is shown on Figure 1.0-3. Background information on the MDA and the sampling plan is presented in Section 5.2.

1.3.1.3 MDA L

MDA L is an inactive chemical waste disposal facility with aboveground active chemical and mixed waste handling and storage units. MDA L was designated for disposal of Laboratory-generated chemical (non-radioactive) wastes.

A volatile organic contaminant (VOC) plume is present in the ground below and surrounding MDA L. The plume is currently monitored by the Laboratory on a quarterly basis. Appendix A of this work plan is a voluntary corrective action plan (VCAP) to remediate the VOC plume. The subsurface disposal units at MDA L will be stabilized to meet conditional remedy requirements. A vapor extration study will be conducted to determine if it is more cost-effective to excavate or treat the source(s) of the VOC plume in-situ than to perform vapor extraction for the long term. The VCAP includes a pilot volatile extraction test program with modeling of the data to assist in this determination. Post-closure care monitoring of the subsurface disposal units at MDA L will be performed to meet conditional remedy requirements.

The surface storage and handling areas within MDA L are not disposal units and can be remediated. However, because they are collocated with the subsurface disposal units at MDA L, the cleanup levels will be based on conditional remedy requirements. It is the Laboratory's intent to let the conditional remedy requirements serve as clean closure standards for those surface units within MDA L subject to the closure regulations. Thus, all of the storage and handling facilities at MDA L will be clean-closed, and no post-closure care monitoring will be required. The location of MDA L is shown in Figure 1.0-3. Background information on MDA L and Sampling Plans are presented in Section 5.3

1.3.1.4 MDA G

MDA G is the low-level radioactive waste landfill for the Laboratory, and will remain so in the future. It is also used for the storage of low-level and transuranic mixed wastes, and will continue to store such wastes until the new transuranic waste certification facility at TA-54 West is opened in 1999.

Table 1-3 lists SWMUs within MDA G and their closure requirements. Remediation of MDA G will be conducted according to DOE Orders, closure plans, and conditional remedy requirements. The location of MDA G is shown in Figure 1.0-3. Background information on this MDA and sampling and analysis plans are presented in Section 5.4.

1.3.2 Conceptual Model for Sites With Recreational Use Access

SWMUs addressed by this conceptual model include potential release sites at TA-51, and the western part of TA-54. Four septic systems have been identified as potential release sites that will require further characterization through development of sampling plans (see Section 5.5). SWMUs located in TA-51 and in the western part of TA-54 are on land that is currently under DOE control. However, the sampling plans for these SWMUs are designed to provide information required for recreational use of the land, assuming eventual transfer of the DOE property to Bandelier National Monument.

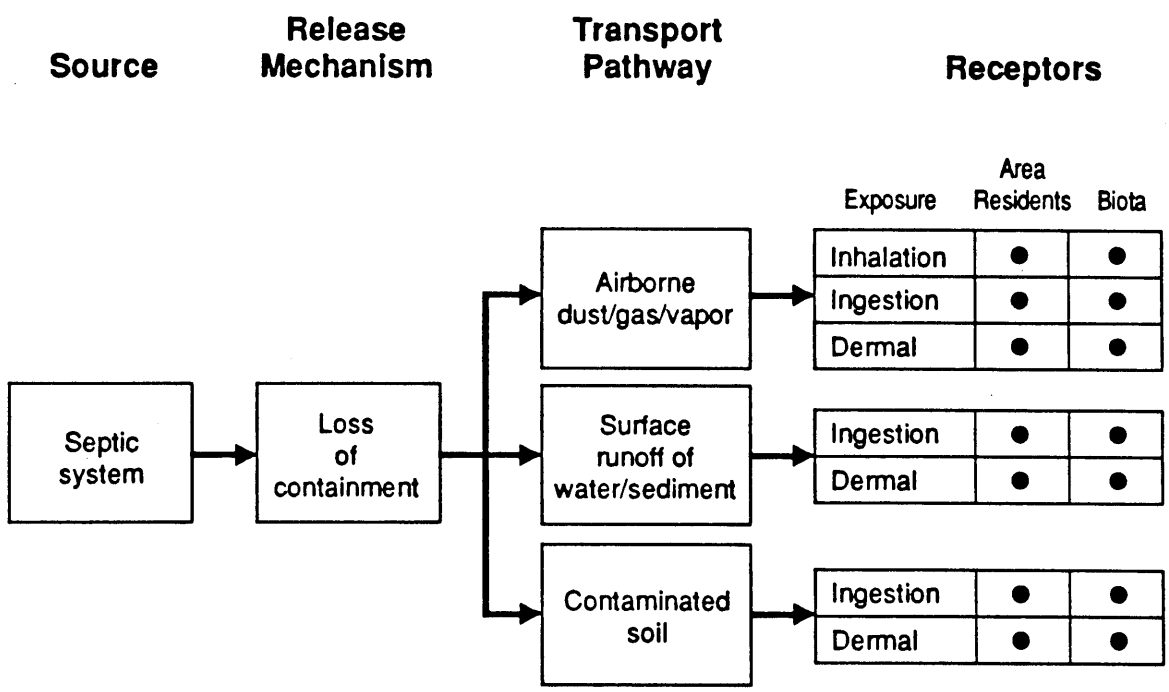


Figure 1.3-2 Conceptual model for areas with intended recreational use.

Figure 1.3-2 presents the conceptual model for the potential release sites. There is no indication that the septic systems received hazardous wastes. However, after each septic system is taken out of service, the absence or presence of contamination will be confirmed by sampling the contents of the septic tanks and sampling soil that received seepage from the septic systems.

The fact that these sites may be open in the future for recreational use under management by Bandelier National Monument requires that contamination be remediated to meet health risk-based standards or action levels required for public access.

The primary release mechanism is the disposal of hazardous waste or radioactive waste to the septic system. Seepage of contaminants from the septic system could result in contamination of the surrounding soil and the underlying tuff. Evapotranspiration could transport contaminants upward into soils at land surface, as could activities by burrowing animals. Man-made excavation of the site could expose contaminants, and over time, natural erosion processes could expose contaminated soil.

Inhalation of contaminated dust or direct ingestion of contaminated soil in the immediate area of septic systems is a potential pathway, as is ingestion of vegetation grown in contaminated soil.

Transport of contaminants off site by surface water runoff pathway or air pathway is possible. However, due to the small size of the source area, dispersion processes in these pathways would result in no impact on receptors. For these reasons, contaminants released from the septic systems are not a concern for groundwater contamination in perched aquifers in the canyons or in the main aquifer deep below the mesa. Brief descriptions of the facilities located in TA-51 and in the western part of TA-54 are given below.

1.3.2.1 TA-51

TA-51 is currently the base of operations for the Experimental Engineering Test Facility (EETF) which supports research to develop effective isolation techniques for the burial of wastes in semi-arid climates. The EETF was built in 1980, and staff support offices in EES-15 were constructed in 1986. The location of the facility is shown on Figure 1.0-3. Additional information and the sampling plan for the septic system is in Section 5.5.

1.3.2.2 Former Animal Holding Facility (TA-54 Western Part)

An animal holding facility was constructed in the western part of TA-54 in the mid 1960s. The facility housed animals used by the Laboratory biomedical research program until the late 1980s. Structures in the inactive animal holding facility are presently being remodelled as a laboratory to analyze environmental samples. The location of the former animal holding facility is shown on Figure 1.0-3. Sampling information and the sampling plan for the septic system is in Section 5.5.

1.3.2.3 Former Radiation Exposure Facility (TA-54 Western Part)

A radiation exposure facility located in the western part of TA-54 was in operation from 1962 to the mid-1970s for biomedical research on the exposure of animals to radiation. The radiation sources were removed from the facility when research was terminated. Currently, the facility is used to study the effects of nitrogen oxides on animals. The location of the facility is shown on Figure 1.0-3. Additional information and the sampling plan for the septic system is in Section 5.5.

1.3.2.4 TA-54-West (TA-54 Western Part)

TA-54 West houses the nondestructive testing (NDT) facility in which transuranic wastes stored at MDA G and destined for emplacement at the Waste Isolation Pilot Plant in Carlsbad, New Mexico will be remotely examined and certified prior to shipment. Construction of the NDT facility was completed in 1990. To date, the facility has performed only limited assay and limited X-ray tests on transuranic (TRU) waste. The location of the facility is shown on Figure 1.0-3. Additional information on the facility is in Sections 5.5 and 6.5 of this work plan.

1.4 Technical Approach

The technical approach used in this work plan focuses efforts on meeting required site characterization objectives in a cost-effective manner.

1.4.1 Summary of the OU 1148 Technical Approach

The logic for the technical approach for OU 1148 is presented in Figure 1.4-1 and is summarized as follows:

- Existing information is reviewed to develop an understanding of the processes and events that produced each SWMU and the constituents of concern (COCs).
- On the basis of existing information, SWMUs are classified into four categories: No Further Action (NFA), Deferred Action (DA), Voluntary Corrective Action (VCA), or Phase I sampling.
- Data gathered during Phase I investigations are used to identify SWMUs that may be recommended for NFA, DA, VCA, and SWMUs that require further characterization with Phase II sampling.

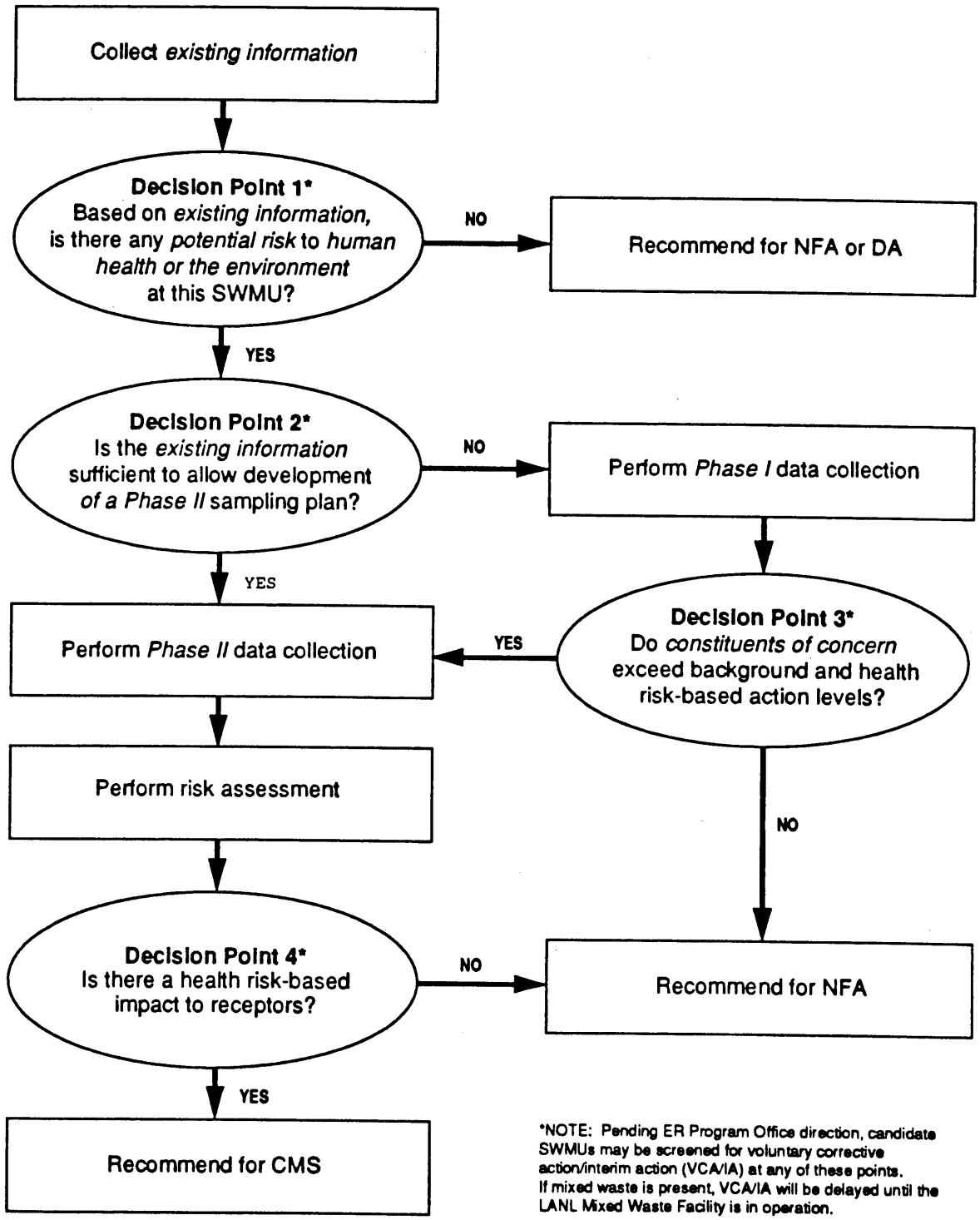


Figure 1.4-1 Decision process for OU 1148 (italicized terms are defined in Table 1.4-1).

- Phase II field investigations are conducted to characterize the nature and extent of contamination and to obtain the data necessary for a quantitative assessment of risk posed by COCs. Technical reports will provide results that will be used to support decisions to either conduct additional Phase II sampling or proceed to the risk assessment process.

- Quantitative risk assessment is conducted for each SWMU when the required data have been obtained.

- An RFI report is compiled that contains the results of field investigations and recommendations for SWMUs evaluated by the decision process. SWMUs are recommended for CMS when the analytical results exceed RCRA Subpart S action levels or health risk-based action values for constituents not addressed in Proposed RCRA Subpart S. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 version of the IWP. This approach will be developed in adequate time for data analysis. The remaining SWMUs are recommended for NFA, or DA.

The approach and decision process used in this work plan are discussed in detail in the following sections.

1.4.2 OU 1148 Decision Process

All SWMUs within OU 1148 were evaluated using the four-step decision process illustrated in Figure 1.4-1. Italicized terms used in this diagram are defined in Table 1.4-1. Each of the four diamonds in the diagram represents a point at which a decision will be made for each SWMU under consideration. To ensure simplicity in the process, each question posed has only two possible answers, "yes" or "no." The process is designed to identify those SWMUs which can be recommended for NFA, VCA, or DA as early in the process as possible, and with the least expenditure of resources. Those SWMUs which cannot be recommended for NFA or DA after Phase I and II investigations and risk assessment are complete will be candidates for a VCA or a CMS. It will be the policy of the ER Program Office to address any short-term problems in the most efficient, justifiable manner feasible. Principles of the "observational approach" described in the IWP (LANL 1991, 0553) will be utilized to focus the corrective action process on the earliest possible implementation of an acceptable alternative. The IWP prescribes that solutions to most short-term problems will take the form of VCAs. Although expeditious implementation of VCAs short circuits the normal corrective action process, any plans for these actions will be subject to the same degree of regulatory scrutiny as plans for final corrective measures which are selected as a result of a CMS. The plans for VCAs must be approved by the EPA prior to use in a corrective action as a final remedy.

1.4.2.1 Observational Approach

This RFI Work Plan employs the observational approach described in Appendix J of the IWP (LANL 1991, 0553).

TABLE 1.4-1
TERM DEFINITIONS

Constituents of Concern: Organic, inorganic, or radioactive solids, liquids, or gases that, due to quantity, concentration, or physical/chemical characteristics, may present a threat to human health or the environment.

Existing Information: Information collected to date from published and unpublished records pertaining to the history or processes of a SWMU. Records can include written communication such as reports, memoranda, letters, notes, or calculations. Verbal communication can be considered as archival data. Archival data generally has unknown data quality.

Human Health or Environment: Pertaining specifically to the health and environment of the general public (exclusive of health concerns for Laboratory employees, which is regulated by OSHA).

Phase I: The initial sampling phase of site assessment work to collect adequate information to confirm the presence or absence of contaminants of concern in the environment. Information collected during Phase I sampling and analysis will determine if Phase II sampling is necessary.

Phase II: The second sampling phase of site assessment at SWMUs that have contaminants of concern. Phase II sampling and analysis will provide required data on the physical-chemical characteristics of the site and will delineate the nature and extent of contamination. Data collected will be used for contaminant fate and transport modeling, risk assessment, treatability studies, and corrective measure studies, as required.

Potential Risk: A judgmental determination on the potential release of contaminants of concern to the environment at a SWMU based solely on archival data. A potential risk is based on the likelihood that a release may have occurred at a SWMU and may have entered a potential migration pathway leading to off-site receptors. Active waste management activities conducted under DOE Orders do not represent a risk to off-site receptors. Because specific SWMUs contain retrievable waste managed under DOE Orders until it is certified as TRU waste that will be packaged to meet WIPP waste acceptance criteria, these SWMUs will be recommended for deferred action at Decision Point 1. Criteria for recommending SWMUs for NFA or DA are given in Tables 1.4-2 and 1.4-3.

Site Characterization: Determination of the properties of the site as related to the potential for human health or environmental risk. The properties can include waste location and extent of migration as well as geological and hydrological properties of the site.

Waste Characterization: Determination of the constituents of concern, their amounts, and their physical and chemical forms. The determination can be made using existing records, or actual analytical measurements.

1.4.2.2 Phase I Sampling Process

Phase I sampling will be performed at SWMUs in which contamination is suspected but not confirmed by existing information. Phase I sampling points can be chosen that have a high probability of yielding definite results. Data acquired through Phase I investigations will serve as inputs for Decision Point 3 which includes the Phase II sampling effort. Results will be analyzed with regard to sources of variability and the impact of variability on the Phase II effort.

1.4.2.3 Phase II Sampling and Modeling Process

The purpose of Phase II sampling is to determine the nature and extent of contamination at a site. As data become available, the Phase II SAPs will be reviewed for completeness and suitability, and the SAPs will be revised as appropriate. The data set resulting from Phase II will meet requirements for risk assessment.

1.4.2.4 Risk Assessment Process

The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 version of the IWP. This approach will be developed in adequate time for data analysis.

1.4.2.5 Decision Point 1:

On the basis of existing information, is there any potential risk to human health or the environment at this SWMU?

The function of Decision Point 1 is to differentiate between SWMUs that clearly do not pose a potential risk to receptors (and are therefore recommended for NFA), those subject to separate regulatory authority and those that will require further investigations. This decision may be made on the basis of qualitative existing information, and requires professional judgment on the part of the decision maker. Each recommendation of NFA must be justified by one or more of the criteria listed in Table 1.4-2 and recommendations for DA must meet the criterion given in Table 1.4-3. SWMUs at OU 1148 recommended for NFA or DA at Decision Point 1, and the criteria used for the basis of such recommendations are discussed in Section 6.

TABLE 1.4-2
CRITERIA USED FOR A RECOMMENDATION OF NFA[1] OR DA[2] AT DECISION POINT 1

NFA CRITERIA

1.)The site was never the location of hazardous- or radioactive-waste generation, treatment, storage, or disposal.

2.)The solid waste management unit (SWMU) was never constructed, installed, or used.

3.)The SWMU was constructed after November 18, 1987 and has always operated under a permit.

4.)The site has undergone or is scheduled to undergo remediation or voluntary corrective action under the RCRA Operating Permit or Interim Corrective Measures. Corrective measures were or will be subject to approval by the Environmental Protection Agency (EPA).

5.)Currently available data indicate that the SWMU has undergone characterization or cleanup, and that constituents of concern (COCs) are not present in concentrations that exceed health risk-based action levels.

DA CRITERIA

1.)The SWMU is an active waste management site subject to separate authority, such as HSWA Section 300(a) or TSCA.

NFA[1]: No Further Action
DA[2]: Deferred Action

TABLE 1.4-3
SOURCE CHARACTERIZATION DATA NEEDED FOR OU 1148 DISPOSAL UNITS

1. Unit/Disposal Area Characteristics

   a. Location;
   b. Type of Units;
   c. Design features;
   d. Operating practices (past and present);
   e. Period of operation;
   f. Age of unit/disposal area;
   g. General physical conditions; and
   h. Method used to close the unit/disposal area.

2. Waste Characteristics:

   a. Wastes placed in the unit:
      i) Volatile organic compound identity
      ii) Hazard class (e.g., radioactive, flammable, reactive, corrosive, oxidizing or reducing agent); and
      iii) Quantity.

   b. Physical and chemical characteristics:
      i) Physical form (solid, liquid, gas):
      ii) Physical description (e.g., powder, oily sludge);
      iii) Temperature;
      iv) pH;
      v) General chemical class (e.g., acid, base, solvent);
      vi) Molecular weight;
      vii) Density;
      viii) Boiling point;
      ix) Viscosity;
      x) Solubility in water;
      xi) Vapor pressure; and
      xii) Type of radiation.

   c. Migration and dispersal characteristics of the waste;

      i) Sorption;
      ii) Biodegradability, bioconcentration biotransformation;
      iii) Photodegradation rates; and
      iv) Hydrolysis rates.

3. Vapor Plume

   i) Chemical identification (Names and class [VOC, semi-VOC, etc.])
   ii) Concentration
   iii) Molecular weight
   iv) Density
   v) Boiling point
   vi) Viscosity
   vii)Solubility in water
   viii) Vapor pressure

4. Plume Model

   a. Plume Definition
      i) Vertical extent of the plume
      ii) Horizontal extent of the Plume
      iii) Constituents of the plume
      iv) Physical parameters of the plume
      v) Chemical parameters of the plume
      vi) Depth to impermeable stratum
      vii) Formation temperature

   b. Permeability
      i) Gas phase permeability
      ii) Gas phase permeability tensor
      iii) Vertical gas phase permeability
      iv) Horizontal gas phase permeability
      v) Ratio of vertical to radial gas permeability

   c. Pump test data (physical data)
      i) Radial distance 1
      ii) Radial distance 2
      iii) Depth 1
      iv) Depth 2
      v) Length of the well screen
      vi) Gas mass flow rate
      vii) Gas mass flow rate per length of well screen

   d. In-situ gas measurements
      i) Gas average molecular weight
      ii) Gas pressure
      iii) Ambient gas pressure
      iv) Gas pressure at observation point 1
      v) Gas pressure at observation point 2
      vi) Dimensionless pressure
         -Drawdown pressure at depths 1 and 2
         -Drawdown pressure at radii 1 and 2
      vii) Continuous gas point sink strength
      viii) Continuous gas point strength per unit screen length

1.4.2.6 Decision Point 2:

Is existing information sufficient to allow development of a Phase II sampling plan?

Existing information will be judgmentally reviewed against several criteria to help determine if Phase I or Phase II sampling is more appropriate. These criteria include the following:

- probability that COCs are present and correctly identified,
- probability that the lateral and horizontal extent are accurately known,
- suitability of existing analytical data (for both location and analytes) for the design of a Phase II SAP, and
- knowledge of experimental or operational processes that contributed to the SWMU waste stream.

Because most of the available information on waste at OU 1148 is from archival records rather than from analysis of waste, field investigation and analysis will be necessary to characterize the waste (e.g., determine all COCs) and to collect data needed for modeling or risk assessment.

Decision Point 2 does not provide a mechanism for recommending SWMUs for NFA or DA. Decisions made at Decision Point 2 produce two sets of SWMUs: one set that requires Phase I sampling and another set that can proceed directly to Phase II sampling. On the basis of existing information, no SWMUs in OU 1148 qualified for Phase II SAPs.

1.4.2.7 Decision Point 3:

Do the data collected in Phase I sampling confirm the presence of COCs at this SWMU?

At Decision Point 3, analytical data are used to identify SWMUs that can be recommended for NFA and SWMUs that require Phase II characterization.

The presence of COCs at a SWMU is considered confirmed if:

- a sample contains any COC in a concentration that exceeds the background level for that constituent when analyzed by SW-846 or Level V analytical methods, and
- the concentration of that COC exceeds a health risk-based action level for that constituent.

If a health risk-based action level for a constituent does not presently exist, then the measurement of a concentration above the detection limit and background level will suffice to be considered sufficient confirmation of the COCs presence, and indication that a health risk-based action level should be developed.

The absence of COCs is confirmed if none of the suspected constituents are detected, or no suspected COCs exceed their respective background levels. The ER Program is currently conducting a pilot study on soils and the Bandelier tuff. The study will determine the background concentration range of target analyte list metals and radionuclides. The investigation will also collect data on some physical and chemical parameters that control mobilities of the constituents. Initial results of the study will be presented in the 1992 version of the IWP, and will be available for use in adequate time for data analysis.

1.4.2.8 Decision Point 4:

Do COCs at this SWMU result in a health risk-based impact to receptors?

The purpose of Decision Point 4 is to allow an evaluation of the total set of valid data for each SWMU. Concentrations of COCs at each SWMU will be compared to the action levels for each COC present. A recommendation of NFA at this point in the decision process will be justified for a SWMU if the mean sample concentration for any listed COC does not exceed the risk-based action level for that COC.

A CMS (or an alternative response action) is required for SWMUs at which one or more COCs are present at a level that exceeds the risk-based action level specified in 40 CFR 264 Proposed Subpart S or the health risk-based level developed by the Laboratory for that constituent. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 version of the IWP. This approach will be developed in adequate time for data analysis. The derivation of action levels for constituents which have no action level under 40 CFR 264 Proposed Subpart S will also be considered in the 1992 IWP. If further site-specific risk assessment indicates that human health and the environment are not at risk, then a recommendation of NFA may be appropriate.

1.4.3 Data Quality Objectives

To ensure that data of appropriate and sufficient type, quantity, and quality are collected during Phase I and Phase II sampling, the Data Quality Objectives (DQO) Process (Neptune 1990 0748, Neptune 1990 0684, Ryti 1990 0714) has been applied to the development of the Phase I and Phase II SAPs.

The seven steps in the DQO Process are as follows:

1.) State the problem to be resolved.

2.) Identify the decision to be made (or the question that must be answered).
3.) Identify inputs to the decision (or identify data needs).
4.) Specify the domain of the decision.
5.) Develop a decision rule (or logic statement).
6.) Develop uncertainty constraints.
7.) Optimize design for obtaining data (develop sampling and analysis plans).

1.4.3.1 Phase I Data Quality Objectives

DQOs for the Phase I SAPs are discussed in following sections and shown in Figure 1.4-2.

1.4.3.1.1 Problem Statement

For many of the SWMUs within OU 1148, some COCs are expected, but no data are yet available on the concentrations or specific locations of contaminants. Environmental samples must be collected and analyzed to confirm the presence or absence of COCs.

1.4.3.1.2 Question to be Answered

Do the data from Phase I sampling confirm the presence of COCs at this SWMU? This question and its two possible answers are discussed in Section 1.4.2.7.

1.4.3.1.3 Decision Inputs/Data Needs

Two sets of decision inputs (data needs) that are necessary to support the decisions made at Decision Point 3 have been identified. These sets include the following:

- information necessary to design an effective Phase II SAP, and
- field and analytical data that will be collected during the sampling program.

The first set includes information that must be gathered before development of the sampling plan. The second set includes the concentrations of COCs at the site as determined by field and laboratory analyses of samples collected at the site. This description includes the COCs that are suspected at each SWMU, and the media in which the COCs are most likely to occur. Selected key samples will be subjected to analysis for the complete set of analytes of concern as given in the Generic Quality Assurance Project Plan (LANL 1991, 0412). This will ensure that potential COCs will not be missed. This description is meant to be a bridge between the development of DQOs and the preparation of the SAPs. Design of the SAP hinges on two important considerations:

- What COCs are suspected at the site at present?
- Where are the highest concentrations of those COCs most likely to occur?

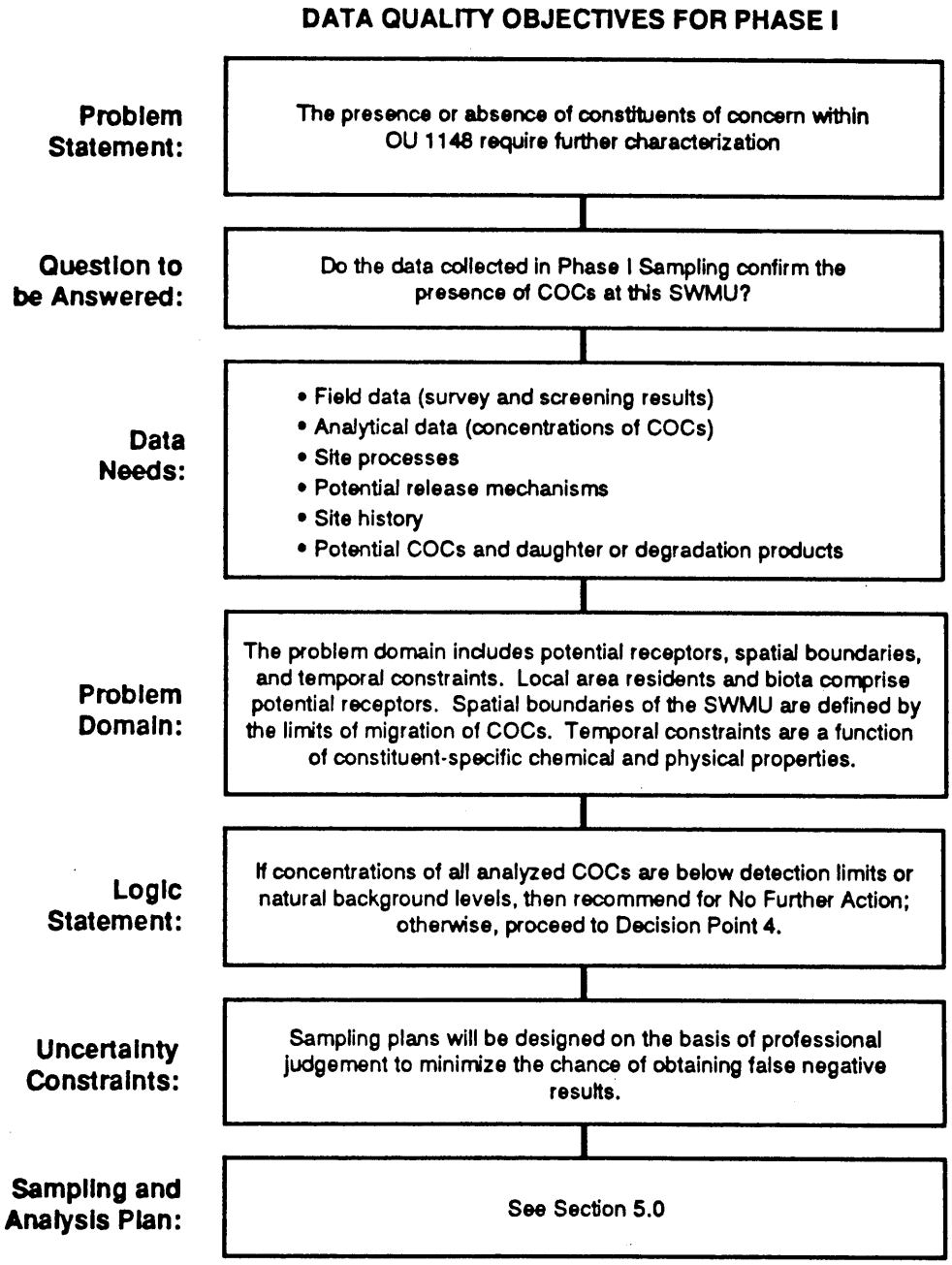


Figure 1.4-2 Data Quality Objectives for Phase I.

Consideration of these questions will help to determine the locations and depths for collection of samples and the list of COCs to be analyzed. Therefore, the following decision inputs must be determined before the SAP development:

- processes that have operated at the site,
- potential historical releases,
- COCs potentially released to the environment,
- likely present state of parent COCs (daughter products of radionuclides, degradation products of organic compounds, etc.), and
- behavior of COCs by medium of concern, including migration potential.

1.4.3.1.4 Problem Domain

The problem domain includes potential receptors (local area residents, site visitors, and biota), spatial boundaries (the area of a release and spatial limits of contaminant migration), and temporal constraints. Under current land use scenarios, OU 1148 SWMUs will remain under DOE control for the foreseeable future with eventual transfer of control to Bandelier National Monument.

1.4.3.1.5 Decision Rule/Logic Statement

The decision made at Decision Point 3 will be based on the following rule:

> If the maximum concentration of any COC in any sample does not exceed detection limits or the natural background concentration for that constituent, the SWMU will be recommended for NFA. Otherwise, the SWMU will undergo further study.

No statistical treatment of the data will be employed in making a decision at Decision Point 3 except for statistical tests of significant difference between the individual sample concentration and the background concentration. Any type of averaging of individual sample results would dilute the maximum value and increase the chances of making a false negative error, determining that COCs are absent when they are actually present.

1.4.3.1.6 Uncertainty Constraints

To fully validate and define a decision to recommend a SWMU for NFA at Decision Point 3, Phase I SAPs have been designed to minimize the chances of obtaining false negative results. This has been done by focusing sampling toward areas judged to most likely contain the highest concentrations of COCs. Although

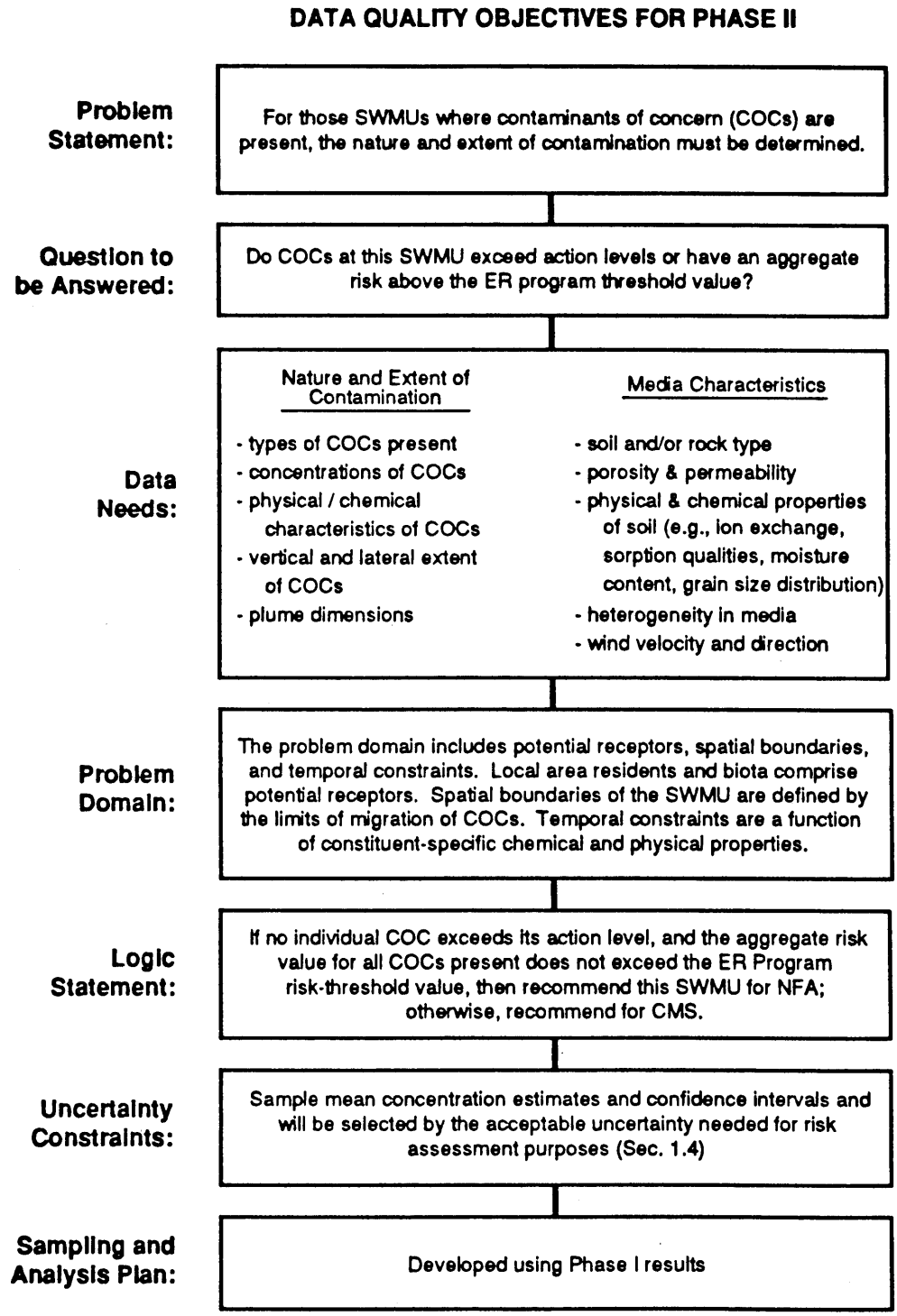


Figure 1.4-3 Data Quality Objectives for Phase II.

statistical interpretation of the Phase I data will be done, no prior constraints were placed before sampling. No attempt is made in Phase I to limit the chances of false positive errors, as these errors would be identified during Phase II sampling.

1.4.3.2 Phase II Data Quality Objectives

DQOs for Phase II SAPs have been developed using the seven-step process and are discussed below and shown in Figure 1.4-3.

1.4.3.2.1 Problem Statement

For the majority of SWMUs in which the presence of COCs has been confirmed, either by existing information or data collected during Phase I sampling, a complete picture of the nature and three-dimensional extent of contamination is not known. Environmental samples must be collected and analyzed to define the nature and extent of contamination so that the health risk posed by the COCs can be assessed.

1.4.3.2.2 Question to be Answered

Do contaminants of concern at this SWMU exceed background concentrations and action levels. This question and its two possible answers are discussed in Section 1.4.2.5.

1.4.3.2.3 Decision Inputs/Data Needs

The purpose of Phase II sampling is to obtain the data needed to support the decision made at Decision Point 4. In general, the information about the nature and extent of contamination at the site must facilitate a health risk assessment. To this end, two sets of decision inputs must be defined during Phase II sampling. These sets include

- the spatial extent of the contaminant plume, in three dimensions, and migration potential over time, and
- the concentrations of all COCs present at various locations and depths within the plume.

To develop a SAP that will obtain these data, all information obtained to date must be considered, including data collected during Phase I investigations. Before an adequate Phase II SAP can be designed, the following decision inputs must be considered:

- What COCs are known to be present at the site?
- Which area(s) is likely to have maximum concentrations of COCs?
- What additional information is needed to perform a risk assessment?

TABLE 1.4-4
TRANSPORT PATHWAY CHARACTERIZATION DATA NEEDED FOR OU 1148 DISPOSAL UNITS

1. Air

   a. A description of climate parameters;
      i) Annual and monthly rainfall averages;
      ii) Monthly temperature averages and extremes;
      iii) Wind speed and direction;
      iv) Relative humidity/dew point;
      v) Atmospheric pressure;
      vi) Evaporation data;
      vii) Development of inversions; and
      viii) Climate extremes that have been known to occur in the vicinity of the facility, including frequency of occurrence.

   b. A description of topographic and manmade features which affect air flow and emission patterns, including:
      i) Ridges, hills or mountain areas;
      ii) Canyons or valleys;
      iii) Surface water bodies (e.g., river, creeks, etc.);
      iv) Wind breaks and forests; and
      v) Buildings.

   c. Wind Erosion Data

2. Tuff

   a. Lithologic descriptions;

   b. Fracture distribution;

   c. Chemical composition

   d. Transects of tuff stratigraphy;

   e. Hydraulic conductivity (saturated and unsaturated);

   f. Relative permeability;

   g. Bulk density;

   h. Porosity;

   i. Soil sorptive capacity;

   j. Cation exchange capacity (CEC);

   k. Organic content;

   l. Rainwater chemistry

   m. pH;

   n. Clay mineralogy;

   o. Depth of water table;

   p. Moisture content;

   q. Effect of stratification on unsaturated flow;

   r. Infiltration

   s. Evapotranspiration;

   t. Storage capacity;

   u. Vertical flow rate;

   v. Mineral content; and

   w. Erodibility.

3. VCAP Data Needs

   a. Pressure
      i) wellhead;
      ii) vacuum pump suction;
      iii) vacuum pump discharge;
      iv) vapor piezometer (drawdown)

   b. Temperature
      i) vacuum pump influent;
      ii) vacuum pump effluent.

   c. Relative humidity of extracted vapor,

   d. Air flow rate
      i) per well;
      ii) total.

   e. Response of air flow rate and vapor piezometer drawdowns to varying wellhead suctions (step test).

   f. Recovery of extraction well and piezometer pressures upon conclusion of vapor extraction (recovery test).

   g. Hydrocarbon removal
      i) total hydrocarbons;
      ii) specific VOC concentrations;
      iii) major gas concentrations (O_2, CO_2, N_2, CH_4, CO); and
      iv) temporal variations in concentration.

   h. Rate of water production, due to condensation from extracted air.

   i. Quality of water produced, for waste disposal considerations.

TABLE 1.4-4, Continued
TRANSPORT PATHWAY CHARACTERIZATION DATA NEEDED FOR OU 1148 DISPOSAL UNITS

j. Emissions treatment considerations, such as carbon consumption rate.

k. Comparison of vertical versus non-vertical well performance.

l. Characterization of contamination in soils, for modeling and disposal considerations.

m. Possibly soil gas samples from new and existing vapor monitoring wells.

4. Surface Water and Sediment

a. Drainage information:
   i) Drainage patterns; and
   ii) Evapotranspiration.

b. Description of the chemistry of the natural surface water and sediments. This includes determining the pH, total dissolved solids, total suspended solids, biological oxygen demand, alkalinity, conductivity, dissolved oxygen profiles, nutrients (NH_3, NO_3/NO_2, PO_4^{-3}), chemical oxygen demand, total organic carbon, specific contaminant concentrations, etc.

c. Description of sediment characteristics including:
   i) Deposition area;
   ii) Thickness profile; and
   iii) Physical - chemical characteristics (organic carbon, pH, ion exchange capacity, etc.)

5. Biological Uptake

a) Terrestrial Ecology
   i) Plant systems;
   ii) Animal populations;
b) Food chain.

1.4.4.1 Analytical Levels

The determination of analytical levels for field and laboratory tasks are required to set data quality standards for the project. Analytical levels are divided into five distinct categories as depicted in Table 1.4-6. Levels III and IV are associated with strict mobile or facility 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 parameters. Investigations at OU 1148 will be performed under a combination of analytical levels to meet the specific needs.

1.4.4.1.1 Phase I Analytical Level

Phase I investigations will be performed under analytical Levels I, II, and III. Level I field screening will include a variety of portable field instrumentation or field test kits that can continually or periodically give information on site conditions. Level I observations are also used as a critical part of the site health and safety plan and for evaluation of samples to determine proper shipping procedures. Additional details concerning the instrumentation and methods for each SAP are given in Chapter 5.

Level II activities will include the use of field survey methods and portable field laboratories (Table 1.4-6). Field surveys include the use of surface or borehole geophysics to assist in remote sensing activities or in the location of sample points. Soil vapor surveys using portable instruments are very useful in providing qualitative to semiquantitative data of samples in the field. Mobile analytical laboratories can provide quantitative information on samples that can be used to support field strategy decisions. At Level II, mobile analytical laboratories will have less rigorous Quality Assurance/Quality Control (QA/QC) and sample documentation.

Level III will be implemented during Phase I activities to obtain quality analytical data from field mobile laboratories or facility laboratories that can support any decisions made for each SWMU. In particular, this data must be of sufficient quality to support a recommendation of NFA. Under Level III at OU 1148, strict QA/QC and sample documentation procedures will be followed (as discussed in Annex II). Laboratory protocol for sample analysis will be performed using EPA's "Test Methods for Evaluating Solid Waste, SW-846," for organic compounds and metals. Radionuclides will be analyzed as outlined in Section 5.4.

1.4.4.1.2 Phase II Analytical Levels

Phase II analytical levels will be similar to those used in Phase I (Levels I, II, and III) with the addition of Levels IV and V. Level IV data quality will be used as appropriate for confirmation of Level III or archival analytical data which can include analyses for nonconventional parameters, method modifications, physical testing of soils or rock or specific constituents specified in 40 CFR 261 Appendix VIII or in 40 CFR 264 Appendix IX. Level V analyses will be performed for all of the nonstandard

TABLE 1.4-6
INSTRUMENTATION AND METHODS FOR PROPOSED ANALYTICAL LEVELS

LEVEL I: FIELD SCREENING

· Portable Instruments

- FIDLER/Violinist
- Photoionization Detector (PID)
- Flame Ionization Detector (FID)
- pH, Temperature, Conductivity Meter

LEVEL II: FIELD SURVEYS/INSTRUMENTATION

- Mobile Analytical Lab (limited QA, documentation)
- Electron Capture Detector (ECD)
- Borehole Geophysics
- Gas Chromatography with a PID, FID, or ECD
- Soil Vapor Surveys (portable instruments)
- Radiological Screening Laboratory
- Combustible Gas Indicator (CGI)
- Oxygen Level Indicator

LEVEL III: LABORATORY METHODS/INSTRUMENTATION

- SW-846 Protocol for soil, air, and water analysis for volatile and semivolatile organic compounds, organochlorine pesticides and PCBs, and metals using Los Alamos, off-site, or mobile laboratories (see Table 5.4-3 for more detail)

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

LEVEL V: LABORATORY METHODS

- ASTM protocol for soil/rock testing
- Method specific protocol
- Laboratory, Department of Energy (DOE), or EPA analytical methods for radionuclides, or miscellaneous analyses (see Generic LANL-ER-QAPjP)

TABLE 1.4-5
RECEPTOR CHARACTERIZATION DATA NEEDED FOR OU 1148 DISPOSAL UNITS

1. General Land Use

   Local uses and possible future uses of surface features draining the facility:
   a. Waste Disposal
   b. Environmental (e.g., wildlife propagation).

2. Human

   Human use of or access to the facility and adjacent lands, including:
   a. Ceremonial (Native American);
   b. Institutional control
   c. Relationship between population locations and prevailing wind direction.

3. Biota

   A description of the biota on, adjacent to, or affected by the facility.

4. Ecology

   A description of the ecology overlying and adjacent to the facility.

5. Demography

   A demographic profile of the people who use or have access to the facility and adjacent land, including, but not limited to: age; sex; and sensitive subgroups.

6. Endangered/Threatened Species

   A description of any endangered or threatened species near the facility.

7. Archeological Sites

   a. Location;
   b. Significance.

8. Risk Assessment

   a. Source strength for each RCRA constituent;
   b. Dispersion coefficients in the y- or z-direction;
   c. Wind velocity in direction m;
   d. Stability criterion for atmospheric dispersion;
   e. Fraction of time wind blows in direction m;
   f. contaminated area of the MDA;
   g. Soil Loss Rate;
   h. Soil Erodibility;
   i. Annual mass of soil eroded from the MDA;
   j. Annual rainfall and runoff factor;
   k. Slope Length Factor; and
   l. Slope Steepness Factor.

The Phase II SAPs will be designed to provide the necessary data to adequately characterize the source constituents, the migration pathways, and the potential receptors. Some of the data that might be required for source characterization are outlined in Table 1-8. This list represents a broad range of potential data needs, based on the present understanding of the conceptual model, and can be modified according to the results of the Phase I sampling effort, and the specific nature of each MDA. Each MDA will have specific data needs as described in Chapter 5. Similarly, Tables 1-9 and 1-10 include a broad range of data needed for pathway characterization and receptor characterization, which are also discussed more specifically for each MDA in Chapter 5.

1.4.3.2.4 Problem Domain

The problem domain for Phase II sampling is the same as that in Section 1.4.3.1.4.

1.4.3.2.5 Decision Rule/Logic Statement

If no individual COC exceeds its background concentrations and action level, the SWMU will be recommended for NFA; otherwise, the SWMU will be recommended for CMS.

1.4.3.2.6 Uncertainty Constraints

The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 version of the IWP. This approach will be developed in adequate time for data analysis. The uncertainty constraints required to allow supportable comparisons with concentrations derived from risk assessments will also be described in the 1992 IWP.

1.4.4 Field and Analytical Data Quality Requirements

Data quality requirements for field and analytical data collected at OU 1148 are governed by the need to make defensible, risk-based decisions for each SWMU. The information collected will be based on sound professional judgment, required EPA protocol, statistical requirements, and overall data objectives for the project. The two-phased site assessment approach proposed for OU 1148 is a logical means of obtaining the goals of the RFI. This section will discuss data quality requirements concerning analytical levels, analytical methods, PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters, and field data quality requirements.

procedures that are not included under Level III analytical methods. Quality control and documentation for Level V will be equivalent to procedures defined for Level III to maintain the defensibility and quality of data.

1.4.4.2 Analytical Methods and PARCC Parameters

Analytical methods for analyzing soil, water, and air samples collected at OU 1148 for the ER Program follow standard laboratory protocol recognized by the EPA. Testing for volatile and semivolatile organic compounds, organochlorine pesticides/ PCBs, and inorganic metals will be performed using EPA's "Test Methods for Evaluating Solid Waste," SW-846 (EPA 1986, 0291). Analytical methods that will be used are specified in Table B.9-1 of Appendix B. Analyses for radionuclides will be performed as described in SAPs developed for MDA G characterization.

Tables V.3 through V.12 and IX.1 in the Laboratory's Generic Quality Assurance Project Plan (QAPjP) (LANL 1991, 0412) contain additional information concerning these analytical methods for constituents of interest at OU 1148. The QAPjP lists the individual constituents analyzed under each method, the corresponding chemical abstract service numbers, and the practical quantitation (PQL) or detection limits (DL) for each constituent.

PARCC parameters are analytical, and sampling quality assurance goals that are established to ensure that quality data are generated. A thorough discussion of the PARCC parameters for the Laboratory ER Program is presented in Section 5.0 of the Generic QAPjP.

1.4.4.3 Sample Collection Quality Requirements

Numerous field activities have an impact on the overall data quality for an environmental restoration program. These 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, specific details for each of these quality assurance activities are included as part of the SAPs (Section 5.0) and in the Laboratory Standard Operating Procedures (SOP) Manual for the ER Program.

1.4.4.4 Decision Analysis Methodology

The decision analysis approach, which provides for efficient identification and evaluation of corrective measures alternatives is described in Appendix I of the IWP. This appendix describes how decision analysis will be used in the ER Program. Because the decision analysis process is being developed concurrently with this work plan, the process will be applied to this operable unit during the first year of field work, reflecting the decision-making framework described in the IWP. Future documents describing work at the operable unit will also reflect this approach.

1.5 Organization of the OU 1148 Work Plan

The OU 1148 RFI Work Plan is prepared pursuant to both the HSWA Module (EPA 1990, 0306) and the IWP (LANL 1991, 0553). The HSWA Module sets out the general scope of the work plan for the RFI; establishes the 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 by the IWP and the OU work plans.

The requirements are summarized in Table 1.5-1 which is extracted from page 32 of the HSWA Module. An additional requirement of the HSWA Module is that detailed outlines for the task-specific RI/FS documents will be provided in the IWP. Table 1.5-2 shows that the OU 1148 work plan explicitly meets the alternate RFI work plan outline given in the IWP (LANL 1991, 0553).

TABLE 1.5-1
RFI GUIDANCE FROM THE LABORATORY'S RCRA PART B PERMIT[1]

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

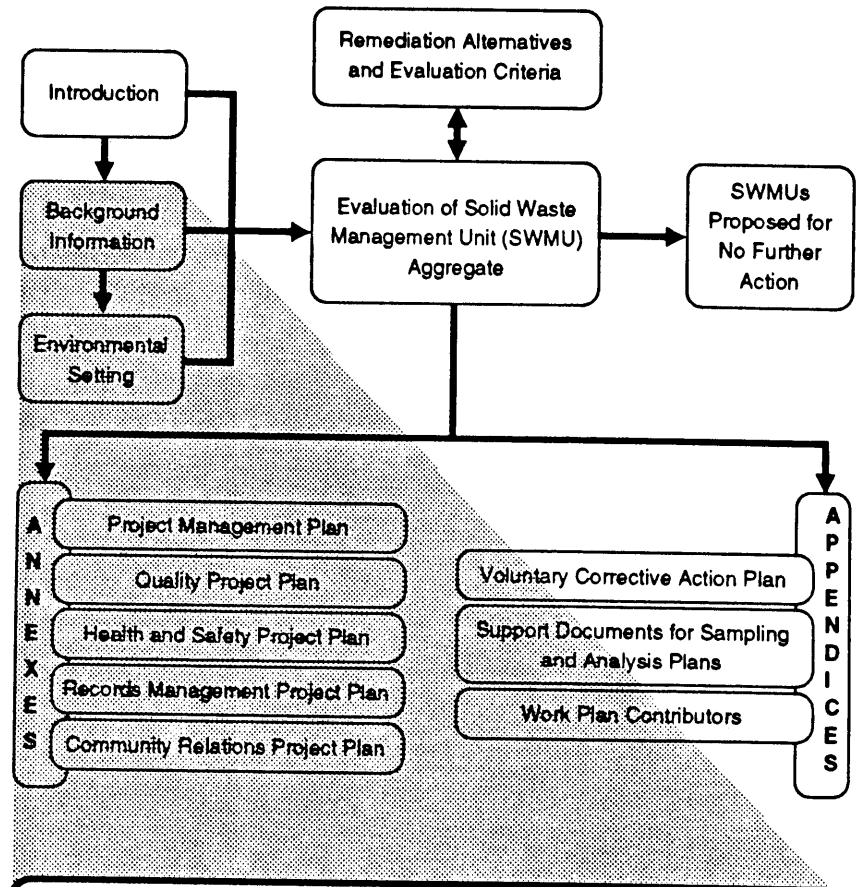
[1] (EPA 1990, 0306)

TABLE 1.5-2
CROSS-REFERENCE OF HSWA MODULE VIII RFI WORK PLAN REQUIREMENTS[1]
AND THE OU 1148 WORK PLAN

HSWA Module VIII RFI Work Plan Requirements		Alternate RFI Work Plan Outline in the IWP	OU 1148 Work Plan Outline
Task I.	Description of Current Conditions		
	A. Operable Unit Background	Chapter 2	Section 2
	B. Nature and Extent of Contamination	Chapter 5	Section 5
Task II.	RFI Work Plan		
	A. Quality Assurance Project Plan and Field Sampling Plan	Annex II Chapter 5	Annex II (Quality Assurance Project Plan) Section 5
	B. Data Management Plan	Annex IV	Annex IV (Records Management Plan)
	C. Health & Safety Plan	Annex III	Annex III (Health and Safety Plan)
	D. Community Relations Plan	Annex V	Annex V (Community Relations Plan)
	E. Project Management Plan	Annex I	Annex I (Project Management Plan)
Task III.	Operable Unit Investigation		
	A. Environmental Setting	Chapter 3	Section 3
	B. Source Characterization	Chapter 5	Section 5
	C. Contamination Characterization	Chapter 5	Section 5
	D. Potential Receptor Identification	Chapter 5	Section 5

[1] 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)

CHAPTER 2



Background Information

- Description
- History
- Past Waste Management Practices
- Current Conditions of Technical Areas in OU 1148

2.0 BACKGROUND INFORMATION FOR OPERABLE UNIT 1148

2.1 Description

Operable Unit (OU) 1148 consists of SWMUs identified in Technical Areas (TAs) 51 and 54. The two TAs are located on an east-west trending mesa (Mesita del Buey) that is bounded by Cañada del Buey to the north and Pajarito Canyon to the south. The TAs are on DOE controlled property. The geographic location of the OU and the boundaries of the TAs are shown on Figures 1.0-1 and 1.0-2 respectively.

TA-51 is currently the base of operations for the Experimental Engineering Test Facility (EETF) which supports research to develop effective isolation techniques for the burial of wastes in semi-arid climates. Experiments include waste cover and stabilization alternatives, land reclamation, and contaminant movement. The EETF was built in 1980, and staff support offices were constructed in 1986.

TA-54 contains four material disposal areas (MDAs G, H, J, and L) and supporting offices. The four MDAs are enclosed by security fences. MDA G has been the low-level radioactive waste landfill for the Laboratory since 1957, and will remain so indefinitely. MDA G is also used for the storage of low-level and transuranic (TRU) mixed waste, and will continue to store such wastes in support of the newly constructed facility at TA-54 West for nondestructive testing (NDT) of TRU waste. MDA H is an inactive, designated permanent disposal facility for the Laboratory that consists of nine shafts in which classified waste was deposited from 1960 until 1986. MDA J is an active disposal facility for disposal of administratively controlled waste, for surface storage of nonfriable asbestos, and for landfarming of petroleum-contaminated soils. Waste disposal began at MDA J in 1961. MDA L is an inactive chemical waste disposal facility in which chemical waste was deposited in pits, impoundments, and shafts from the late 1950s until 1985. Active chemical and mixed waste handling and storage units are now present on the surface. MDA L is permitted for hazardous waste storage and the Laboratory intends to reserve the space for this purpose indefinitely.

The western part of TA-54 houses the former radiation exposure facility which is currently being used to study the effects of nitrogen oxides on animals. There are no radiation sources at the facility. The former animal holding facility in the western part of TA-54 is currently being remodelled for use in operations at the TA-54 West NDT facility. TA-54 West is the site of final verification testing and certification of radioactive TRU waste that will be transported to the Waste Isolation Pilot Project (WIPP) site. Construction of the facility was completed in 1990, but operations to test waste have not been initiated. The locations of MDAs and other facilities in the OU are shown in Figure 1.0-3.

2.2 Operational History

Since the designation of the Mesita del Buey for military and scientific purposes in 1942, the primary function of OU 1148 has been to serve as a waste disposal area for the Laboratory. A chronological history of operations at OU 1148 is shown in Table 2.2-1. In the following section, the past waste management practices at the OU 1148 MDAs and facilities are discussed in detail.

2.3 Past Waste Management Practices

Radioactive waste disposal began at TA-54 in 1957 when MDA G, the largest disposal area at the Laboratory, was chosen for this purpose. MDA G was an isolated location that offered ample space for disposal activities over a period of years (Rogers 1977, 0216). Prior to the designation of MDA G for radioactive waste disposal, low-level radioactive solid wastes were landfilled at various sites throughout the Laboratory.

The disposal of nonradioactive chemical wastes at TA-54 commenced in the late 1950s with the excavation of Pit A at MDA L. Additional pits, surface impoundments, and shafts were excavated in the 1970s and 1980s as the volume of chemical wastes generated at the Laboratory increased along with the need for centralized waste management facilities.

The Laboratory used MDA H for the disposal of classified wastes from May 1960 to August 1986. MDA H contains nine disposal shafts that are located within a fenced, rectangular area. Eight of the disposal shafts are sealed. The one shaft that is not sealed last received waste in 1986. The Laboratory does not currently plan on depositing additional waste in MDA H.

The Laboratory began disposing of administrative-controlled waste at MDA J in 1961, with the excavation of Pit 1. Administratively-controlled wastes are those nonhazardous, nonradioactive wastes over which the Laboratory wishes to maintain ongoing control, even after disposal. The wastes themselves are largely innocuous: paper, degaussed magnetic computer tape, safe locks, and treated sand from the pads on which explosives are tested. Two pits were excavated, filled, and closed (Section 5.1). Two disposal shafts were excavated; one is filled, and is scheduled to be sealed in 1992. Currently, one pit and one shaft are actively used for waste disposal; two new pits have been excavated and are presently empty.

A radiation exposure facility located in the western part of TA-54 was in operation from 1962 to the mid-1970s for biomedical research on the exposure of animals to radiation. The radiation sources were removed from the facility when research was terminated. Currently, the facility is used to study the effects of nitrogen oxides on animals. An animal holding facility was constructed in the western part of TA-54 in the mid 1960s. The facility housed animals used by the Laboratory biomedical research program until the late 1980s. Structures in the inactive animal holding facility are presently being remodelled as an analytical laboratory for environmental samples.

TABLE 2.2-1
HISTORY OF OPERATIONS AT OPERABLE UNIT 1148

Beginning Date	End Date	Location and Operation
1942	Present	Mesita del Buey, including OU 1148, is designated for military and scientific purposes.
1950s	1985	TA-54 MDA L is used for the disposal of nonradioactive chemical wastes. Other activities include chemical waste treatment and storage.
1957	Present	TA-54 MDA G is used for disposal of radioactive wastes.
1961	1986	TA-54 MDA H is used for the disposal of classified wastes.
1961	Present	TA-54 MDA J is used for the disposal of nonhazardous, administratively controlled wastes, nonfriable asbestos storage, and land-farming of petroleum-contaminated soils.
1962	Mid 1970s	TA-54 Radiation Exposure Facility is used for biomedical research on the exposure of animals to radiation.
Mid 1960s	Late 1980s	TA-54 Animal Holding Facility is used to house animals for the Laboratory Biomedical research program.
1980	Present	TA-51 Experimental Engineering Test Facility supports research to develop effective isolation techniques for the burial of wastes in semi-arid climates.
1985	Present	TA-54 MDA L is used for the treatment and storage of nonradioactive chemical wastes (no waste disposal).
1987	Present	TA-54 Former Radiation Exposure Facility is used for research on the exposure of animals to the oxides of nitrogen.
1990	Present	TA-54 West includes facilities for nondestructive testing of TRU waste containers and for preparation of TRU waste containers for shipment.
1990	Present	TA-54 Former Animal Holding Facility is remodeled as an analytical laboratory.

TA-54 West houses the nondestructive testing (NDT) facility in which TRU wastes stored at MDA G and destined for emplacement at the Waste Isolation Pilot Plant in Carlsbad, New Mexico will be remotely examined and certified prior to shipment. Construction of the NDT facility was completed in 1990. To date, the facility has only performed limited assay and X-ray tests on TRU waste, and the facility will not be ready for full-scale operation until all DOE safety and environmental documentation has been reviewed and approved. The primary wastes generated at TA-54 West so far have been office sanitary wastes.

TA-51 is currently the base of operations for the Experimental Engineering Test Facility (EETF) which supports research to develop effective isolation techniques for the burial of wastes in semi-arid climates. The EETF was built in 1980, and staff support offices in EES-15 were constructed in 1986.

2.4 Current Waste Management Practices

Operations at TA-54 are currently under the administrative control of the Laboratory's Waste Management Group, EM-7. The overall objective of the Waste Management Group is to safely manage liquid and solid wastes generated throughout the Laboratory to prevent the release of radioactive and hazardous materials to the environment. Current operations at TA-54 support this objective through the collection, transport, treatment, storage, and disposal of wastes pursuant to applicable federal and state regulations and DOE requirements. In addition, the operations at TA-54 support Laboratory-wide efforts to minimize the generation of wastes through proper segregation, recycling and reuse, and on-going research activities to reduce the quantities of radioactive and hazardous wastes so that treatment, storage, and disposal operations are minimized.

2.4.1 TA-54, MDA J

The Chemical and Mixed Waste Section, which operates MDA L, is also responsible for the management of nonregulated, administratively-controlled and classified wastes that the Laboratory maintains onsite. These wastes are disposed at MDA J, and consist solely of nonhazardous and nonradioactive solid wastes. Asbestos contained in plastic bags is stored in roll-off dumpsters, and beginning in January 1991, petroleum-contaminated soil from underground storage tank releases was thin-spread in a separate area (these wastes are not classified as hazardous pursuant to 40 CFR 261). The purpose of the land farming project is to remediate the soil through biodegradation and volatilization processes. Additional information on MDA J is in Section 5.1 of this work plan.

2.4.2 TA-54, MDA H

MDA H was used for the disposal of classified wastes from May 1960 to August 1986. No waste disposal has occurred at MDA H since 1986, and the Laboratory has no plans for additional waste disposal there. Of the nine disposal shafts constructed at MDA H, eight have been sealed and covered so that their exact location is not

obvious. The area containing the nine disposal shafts is fenced, with locked gates to prevent unauthorized access. Additional information on MDA H is in Section 5.2 of this work plan.

2.4.3 TA-54, MDA L

The Chemical and Mixed Waste Operations Section of the EM-7 Waste Management Group collects chemical wastes at the generator sites and transports them to MDA L for appropriate treatment, storage, or disposal. MDA L is designated for chemical and low-level mixed waste treatment and storage, PCB-contaminated waste storage, and nonhazardous chemical waste storage.

The hazardous waste units are operated in compliance with the Laboratory's Resource Conservation and Recovery Act (RCRA) permit. Mixed waste container storage units are under RCRA interim status awaiting modification of the permit by the New Mexico Environment Department (NMED). All waste management activities are conducted within the framework of standard operating procedures and operating instructions, which themselves reflect broader Laboratory and DOE Environmental, Safety and Health (ES&H) policy and guidance. For example, wastes are segregated by Department of Transportation (DOT) hazard class prior to treatment, storage, and disposal, and all containers must meet DOT requirements. Recordkeeping has also improved over the years; today wastes are received at MDA L only after chemical/physical analysis or documented process knowledge is deemed satisfactory to allow for safe handling. Finally, employee training and emergency response procedures provide for improved recognition of and response to incidents so that releases can be quickly mitigated. There have been no recorded incidents at MDA L that required implementation of the RCRA contingency plan for that facility (Benchmark 1991, 08-0002).

Sands known to be contaminated with barium are received at MDA L and treated in tanks while held in storage. The treatment immobilizes the barium in the sand by forming a precipitate of barium sulfate which is not extractable in the TCLP characteristics test and is therefore not a RCRA hazardous waste. A total metals test performed on the sands after treatment would identify any other metals present that require treatment. Following treatment, the sand and the barium sulfate are sent to MDA J for disposal.

Hazardous wastes managed at MDA L include laboratory and process chemical wastes generated throughout the Laboratory. Much of the waste consists of laboratory reagents and the waste products of chemical research. While some wastes are received in bulk form, others, such as small containers of chemicals and residues, are labpacked after proper segregation. Mixed wastes stored at MDA L include scintillation vials containing volatile organic liquids and low levels of radioactivity. These wastes are processed through a vial crusher to separate the liquids from the glass containers. The liquids are then packaged and stored for eventual incineration while the glass is disposed onsite at the MDA G low-level disposal site. Lead stringers contaminated with low levels of radiation are also stored in two shafts at MDA L. These are classified as interim status container storage units pursuant to the Laboratory's mixed waste Part A RCRA permit application.

In recent years, MDA L has been storing unusable gas cylinders collected throughout the Laboratory. Gas cylinders classified as hazardous waste are stored pursuant to the RCRA permit; mixed waste gas cylinder storage complies with RCRA interim status requirements.

Polychlorinated biphenyls (PCBs) are also managed at MDA L. PCB oils and PCB-containing equipment, such as capacitors and transformers, are stored in accordance with the requirements under the Toxic Substances Control Act (TSCA). These wastes are transported offsite to be incinerated at EPA- and Laboratory-approved facilities. Additional information on MDA L is presented in Sections 5.3 and 6.3 of this work plan.

2.4.4 TA-54, MDA G

The Radioactive Waste Section of the EM-7 Waste Management Group is responsible for the safe management of low-level and TRU wastes generated at the Laboratory. Wastes are managed in accordance with established waste certification programs in compliance with DOE Order 5820.2A.

Currently, approximately 160,000 ft^3 per year of non-RCRA regulated low-level waste are deposited in pits at MDA G. A compacting and baling operation provides a 5:1 reduction in volume of compatible wastes prior to disposal. About 70% of the low-level wastes includes contaminated equipment and other debris that are placed directly into the pits. Certain nonreactive, nonhazardous chemical wastes that contain low levels of radioactivity, such as asbestos, empty pesticide containers, and PCB-containing solids, also are approved for pit disposal.

A number of shafts (up to 12 ft in diameter and 65 ft deep) are used for the disposal of materials that may include tritium, mixed fission products, uranium, activation products, highly activated pieces of equipment, PCBs, and radioactively-contaminated animal tissues.

Another responsibility of the Radioactive Waste Section is managing solid TRU waste at MDA G. Until TRU waste may be sent from the Laboratory to the DOE's WIPP facility, it is retrievably stored in 55 gal. steel drums or large steel boxes. Approximately 261,300 ft^3 of TRU waste was generated and stored before WIPP waste acceptance criteria were developed. Most of the previously generated uncertified TRU waste is currently stored on three asphalt pads above ground and one earth-covered pad, while the WIPP-certified wastes are stored in an expandable tension-support structure of reinforced vinyl on aluminum I-beams. The present generation rate of TRU waste is 7,060 ft^3 per year. Additional information on MDA G is presented in Sections 5.4 and 6.4 of this work plan.

2.4.5 TA-54, Western Part

The western part of TA-54 houses the former radiation exposure facility which is currently used to study the effects of nitrogen oxides on animals. There are no radiation sources at the facility. The former animal holding facility in the western part of TA-54 is currently being remodelled as an analytical laboratory for environmental samples.

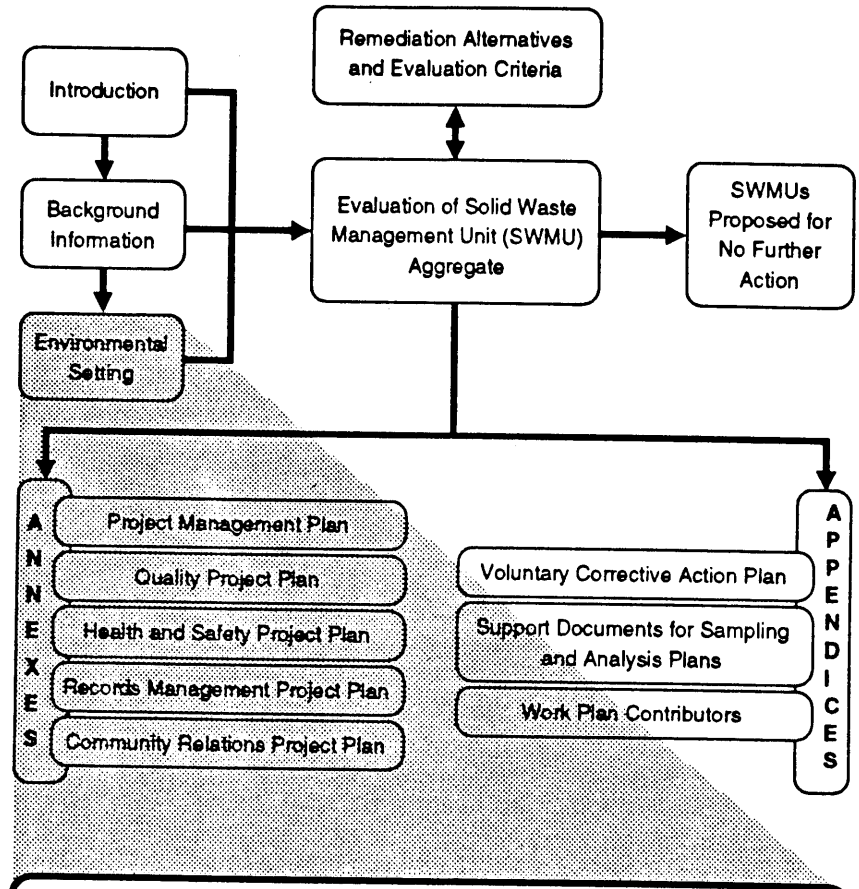
The facilities at TA-54 West will be used to certify TRU wastes that were generated prior to the development of WIPP acceptance criteria. The NDT facility at TA-54 West provides real-time radiography and neutron assay equipment to examine and certify wastes. The wastes will be examined for liquid content, pressurized containers, and general waste form, for example, to insure that prohibited wastes or problematic conditions are identified and the waste modified as required. The TRUPACT-II loading facilities are also located at TA-54 West; these will prepare the shipping packages and load the WIPP-destined transportation vehicle with certified TRU wastes.

The only SWMUs identified in the western part of TA-54 recommended for Phase I investigation are three active septic systems, none of which is expected to have received radioactive or hazardous wastes. The SWMUs in the western part of TA-54 have been combined with the TA-51 SWMUs to form the TA-51/54 SWMU Aggregate for the development of field sampling plans. This aggregation is practical because the only SWMUs recommended for further investigation in the SWMU aggregate are septic systems. Additional information on SWMUs in the western part of TA 54 is presented in Sections 5.5 and 6.5 of this work plan.

2.4.6 TA-51

The EETF facility at TA-51 currently supports research in waste cover and stabilization alternatives, land reclamation, and contaminant movement. It includes two sets of research caissons which are used to study the movement of water through various cover materials and tuff. These caissons have never managed radioactive or hazardous materials. The only SWMU identified at TA-51 which is recommended for further investigation is the active septic system, which is not expected to have received radioactive or hazardous wastes. Additional information on the SWMUs in TA-51 are presented in Sections 5.5 and 6.5 of this work plan.

CHAPTER 3



Environmental Setting

- Topography
- Climate
- Soils
- Hydrology
- Geology
- Biota
- Three-dimensional Geologic/Hydrologic Model

3.0 ENVIRONMENTAL SETTING

The Mesita del Buey, including TAs 54 and 51 within OU 1148, has been designated for military and scientific purposes since 1942. The following sections describe the environmental setting of the operable unit. The historical operational and waste management practices at the operable unit, and the current activities there have been summarized in Chapter 2, and the data needs for environmental restoration at the operable unit are be summarized in Chapter 5. This section identifies the environmental concerns associated with OU 1148. This section presents the three dimensional geologic/hydrogeologic model based upon the present understanding of the environmental setting and the conceptual model for the MDAs and also demonstrates the need to conduct generic framework studies.

3.1 Topography

The geographic setting of the Laboratory is described in the IWP in Section 2.1,"Geographic Setting". TA-51 and TA-54 are located on Mesita del Buey, a relatively narrow, gently sloping mesa that is bordered on the northeast by Canada del Buey and on the southwest by Pajarito Canyon. Mesita del Buey decreases in elevation from about 7020 ft at TA-51 in the west to about 6650 ft at MDA G in TA-54 in the east. Mesita del Buey is about 1400 ft wide at TA-51. It narrows to about 400 ft at MDA L, and widens to about 1000-1300 ft at MDA G. The south side of Mesita del Buey at MDA G is deeply incised by multiple side drainages that drain into Pajarito Canyon. Pajarito Canyon is about 220 ft deep at TA-51 and 130 ft deep at MDA G, and Canada del Buey is about 160 ft deep at TA-51 and 110 ft deep at MDA G.

3.2 Climate

Los Alamos County has a semiarid, temperate mountain climate. The climate of the county, including frequency analyses of extreme events, is discussed in detail in Bowen (Bowen 1990, 0033) and summarized in the IWP in Section 2.5.3, Climate. Climatic aspects of interest include

- atmospheric transport of contaminants: wind speed, frequency, direction, and stability classification;
- atmospheric pressure cycling ("pumping") resulting in the movement of vapors to the surface; and
- surface water run-off and infiltration: precipitation form, frequency, intensity, and evaporation potential.

Wind speed and direction[1] are measured at five locations around the Laboratory, including MDA G, as indicated in Figure 3.2-1. The monitoring station at MDA G has been in operation since 1980, with data collected at a height of about 39 ft above the ground. Winds vary dramatically with time of day, location, and height above ground

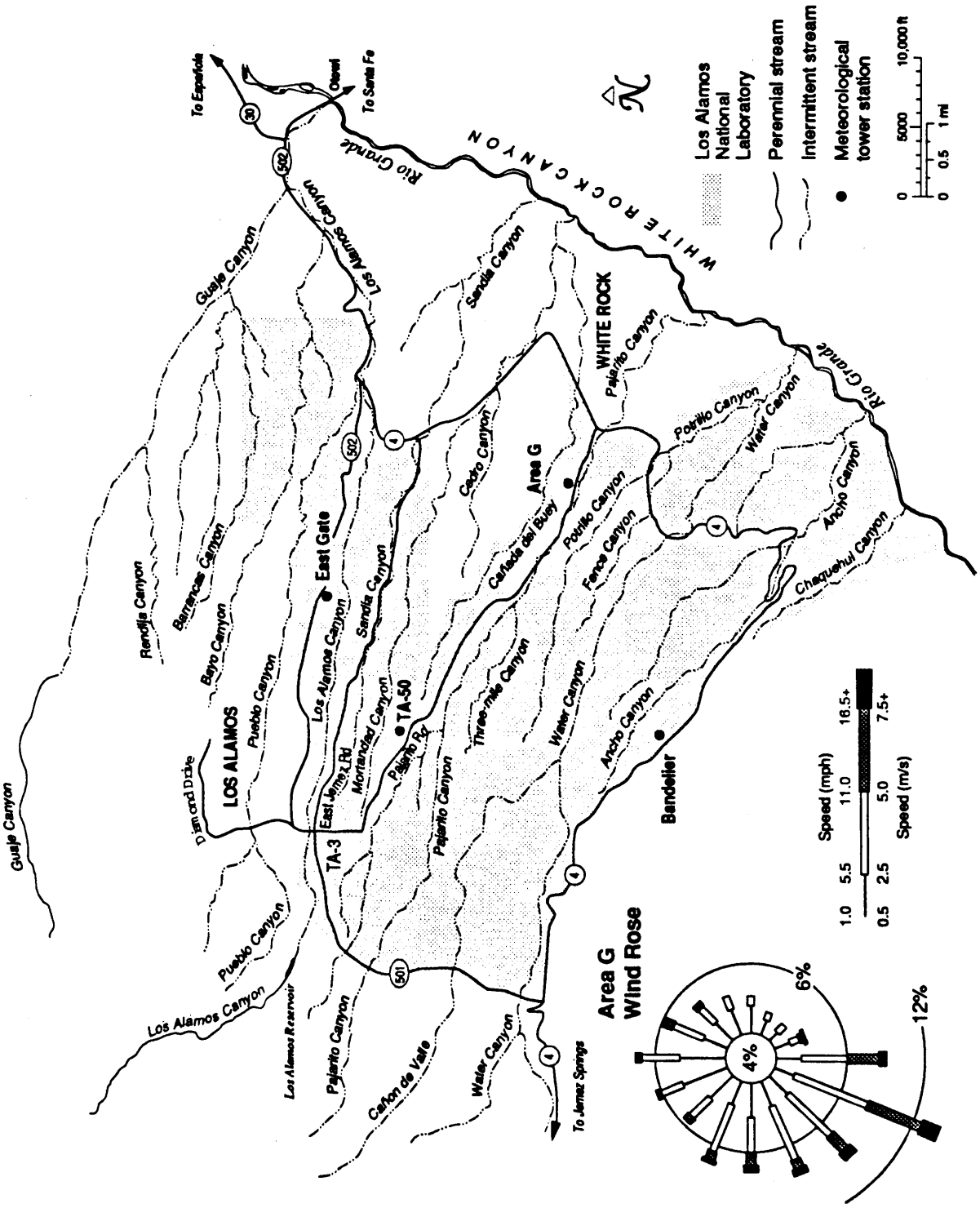


Figure 3.2-1 Meteorological tower locations at LANL, and annual total wind rose for Area G (data from 1980 to 1988) (Bowen 1990).

level. Figure 3.2-2 presents annual wind roses for daytime and nighttime conditions, and for total daily (day and night) conditions at MDA G. All three wind roses show predominant south-southwesterly winds, blowing up the Rio Grande valley, although a more westerly, downslope component from the Jemez Mountains is common at night. Total wind roses for the four seasons (measured in January, April, July, and October) are also shown in Figure 3.2-2. Although the high frequency of south-southwesterly winds is still evident in the four wind roses, seasonal variations in the frequency of wind directions is evident. For example, the January wind rose indicates the same frequency for both a northerly and a southwesterly wind, although the monthly winds tend to be weaker. The July wind rose shows a higher frequency of southerly winds than other seasons (Bowen 1990, 0033).

Figure 3.2-3 presents hourly wind direction frequencies and mean windspeeds at the 35 ft level of MDA G. The January graph shows a definite diurnal pattern in the main wind direction (i.e., northerly drainage winds during nighttime and channeled southwesterly winds during the day). The April and July hourly wind direction frequency curves indicate much less of a diurnal pattern than was evidenced in January. The October hourly wind direction curve shows an increasing diurnal pattern similar to that for January as drainage winds increase with the advent of winter. More than 40% of the surface winds have speeds less than 5.5 mph, and wind speeds greater than 11 mph occur between 10% and 20% of the time. Many of the strongest winds occur in the spring, predominantly from the south-southwest (Bowen 1990, 0033).

Summer afternoon temperatures in Los Alamos County are typically in the 70s and 80s (°F), infrequently reaching 90°F, and nighttime temperatures are typically in the 50s (Figure 3.2-4). Typical winter temperatures are from 30 to 50°F in the daytime and from 15 to 25°F at night, occasionally dropping to 0°F or below (Bowen 1990, 0033).

Annual average precipitation at MDA G is about 14 in., with about 40% occurring as brief, intense thunderstorms during July and August (Figure 3.2-5). Snowfall is greatest from December through March, with heavy snowfall infrequent in other months (Figure 3.2-4). Annual snowfall averages about 51 in. at TA-54. Variations in precipitation from year to year can be quite large, and annual precipitation extremes in Los Alamos range from 6.8 to 30.3 in. Daily rainfall extremes of 1 in. or greater occur in most years, and the estimated 100-year daily rainfall extreme is about 2.5 in. Precipitation generally increases westward towards the Jemez Mountains (Figure 3.2-5) (Bowen 1990, 0033), and is thus slightly greater at TA-51 than at MDA G.

Runoff of surface water can occur during either summer thunderstorms or snowmelt periods. The greatest amount of runoff, and therefore the greatest potential for erosion and transport of surficial contaminants, probably occurs during high intensity summer thunderstorms, although little data on runoff and erosion are available. Infiltration of water into the soil and underlying tuff can also occur during either summer thunderstorms or snowmelt periods. There is probably a potential for deeper infiltration in the snowmelt periods because of lower evapotranspiration rates during the shorter winter days when solar radiation and plant activity are at a minimum. In summer, when evapotranspiration rates are highest, there should be less potential for infiltration. The least amount of estimated evapotranspiration at

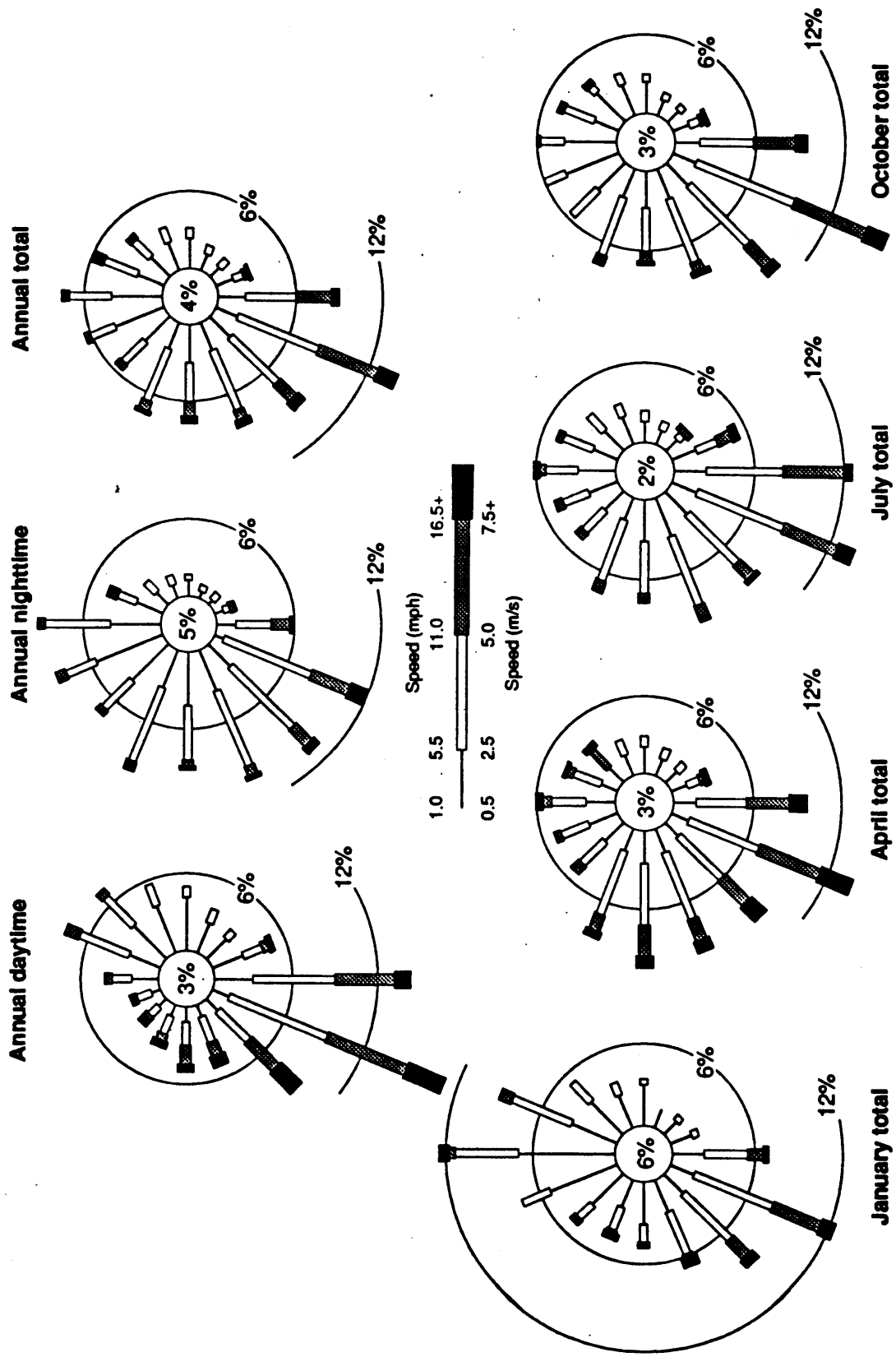


Figure 3.2-2 Annual wind roses for daytime, nighttime, total wind rose and months January, April, July and October.

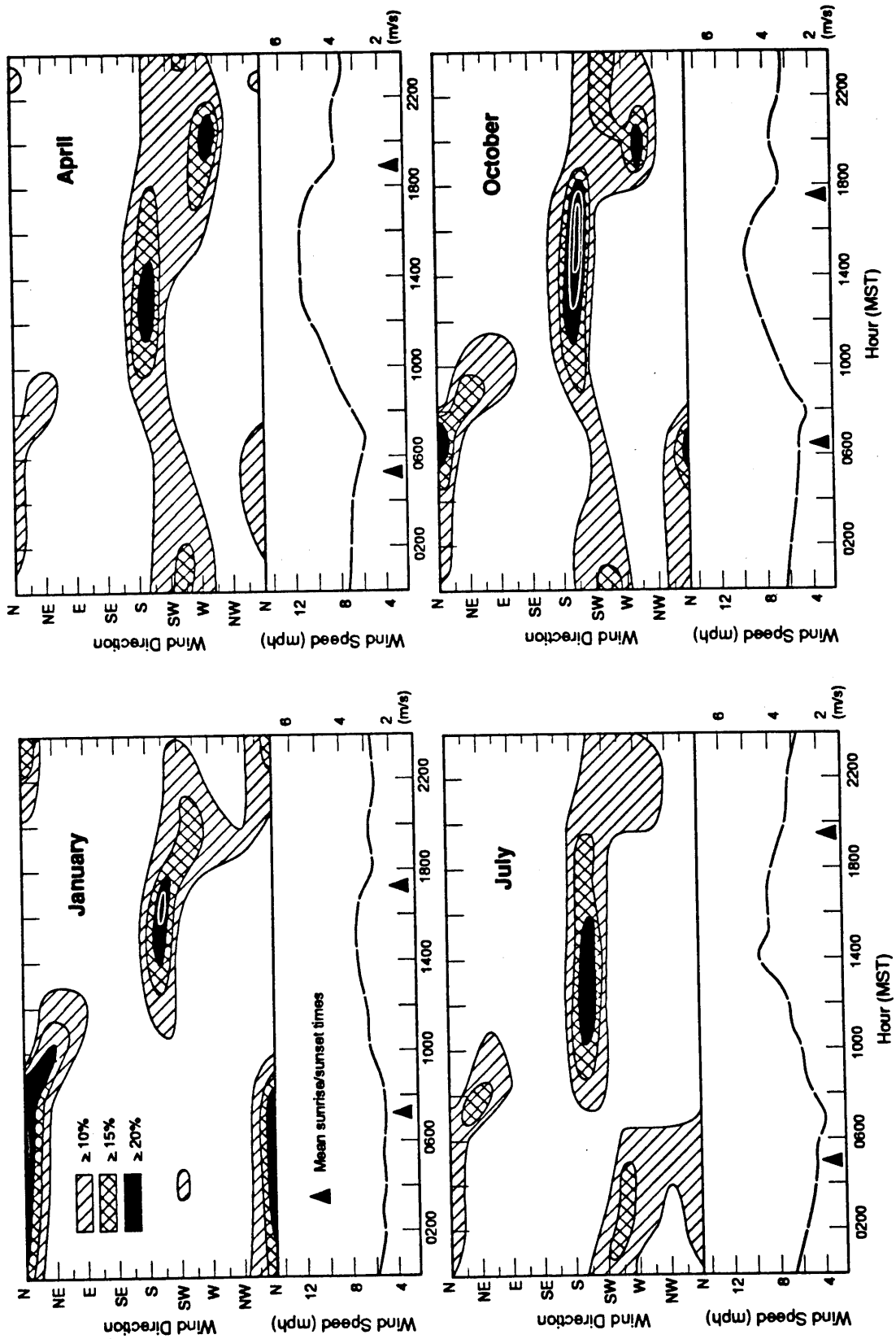


Figure 3.2-3 Hourly wind-direction frequencies and mean wind speeds at meteorological tower in MDA G (35 ft).

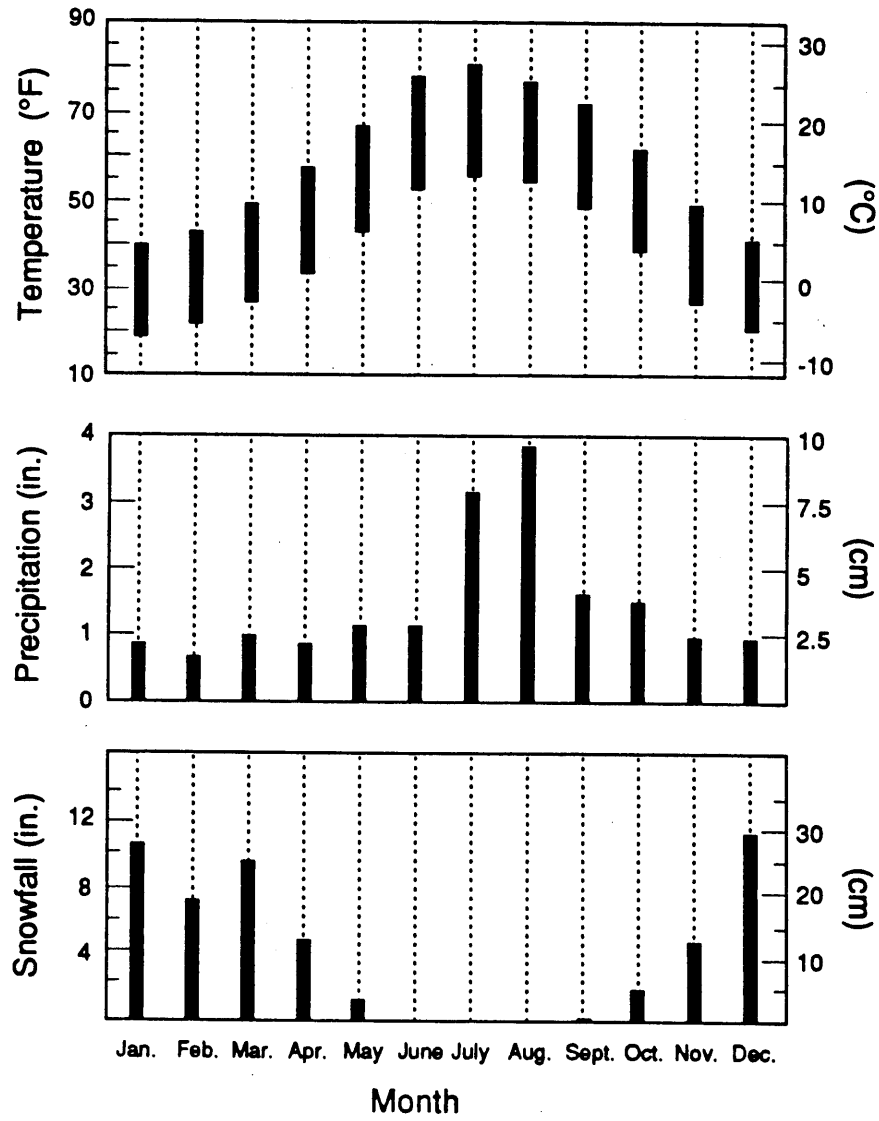


Figure 3.2-4 Yearly distribution of average monthly temperature, precipitation, and snowfall at TA-59 (Bowen 1990).

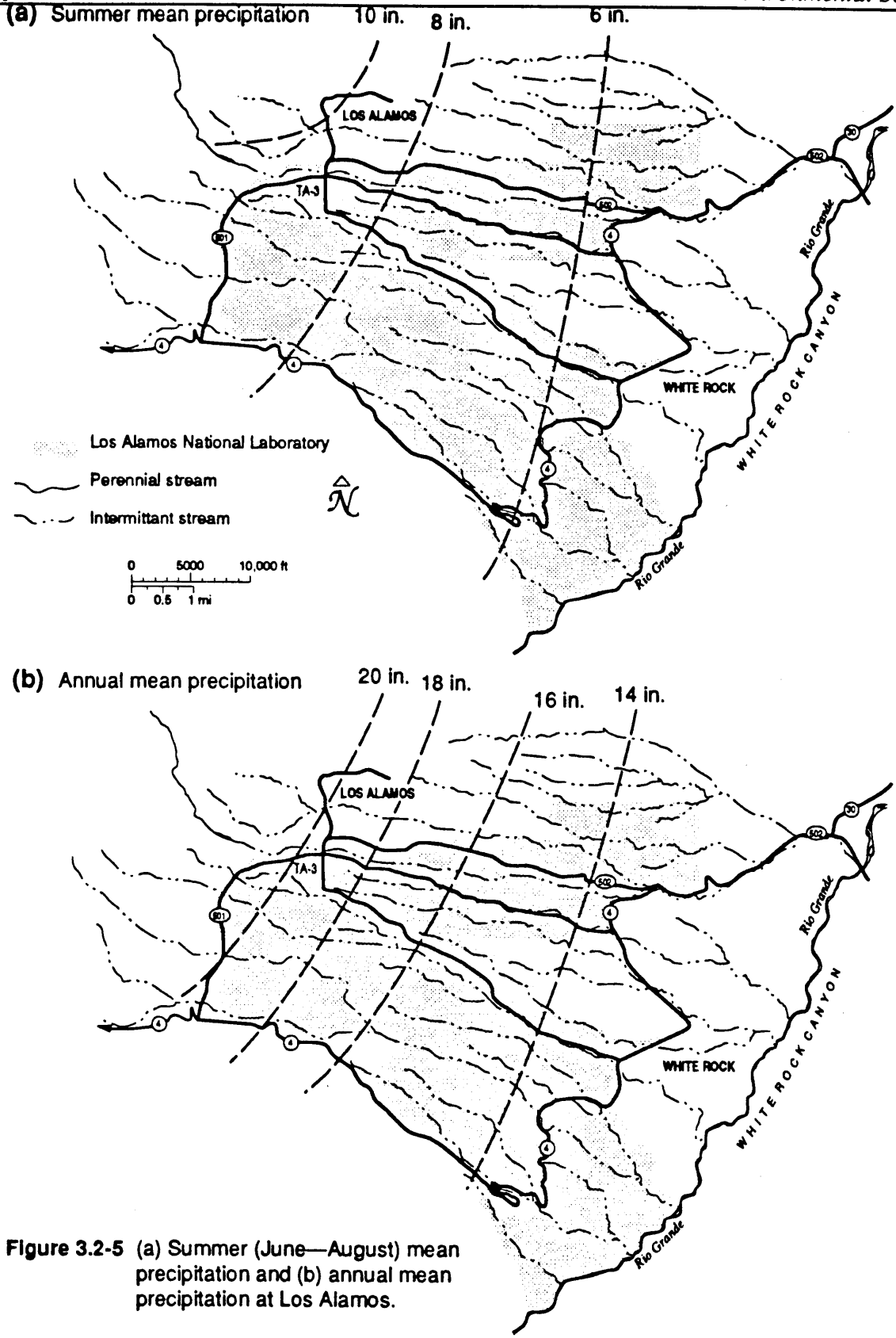


Figure 3.2-5 (a) Summer (June—August) mean precipitation and (b) annual mean precipitation at Los Alamos.

TA-51 sites of trench-cover design experiments occurs in late fall and winter--less than 0.1 cm/day, and the greatest during the summer--greater than 0.2 cm/day (Nyhan et al. 1989, 0171).

An extension of the historic record of annual precipitation at Los Alamos has been presented with a study that correlated historic precipitation and tree-ring widths (Abeele 1980, 0637). Using an index of tree-ring width, the largest estimated precipitation in the last 100 years is about 31 in. occurring in 1919 AD, which agrees well with the estimated 100-year precipitation of 30 in. based on historic climatic records. The estimated maximum annual precipitation during the period of tree-ring record was about 40 in. in 1597 AD (Abeele 1980, 0637).

3.3 Soils

Soils on Mesita del Buey are derived from Bandelier Tuff bedrock and were formed under a semi-arid climate. Soils on the mesa top are mainly thin, well-drained sandy loams of the Hackroy series (Nyhan et al. 1978, 0161). "The surface layer of the Hackroy soils is a brown sandy loam, or loam, about 10 cm [3.9 ins.] thick. The subsoil is a reddish brown clay, gravelly clay, or clay loam, about 8 inches [7.9 in.] thick. The depth to tuff bedrock and the effective rooting depth are about 8 inches to 20 inches [7.9 to 19.7 in.]" (Nyhan et al. 1978, 0161). Clay-rich subsurface horizons, such as those that occur in the Hackroy soils, are believed to have been formed by the translocation of suspended clay from the upper horizons, and the reddish colors record extensive chemical weathering. The development of such soils in a semiarid climate is believed to have taken at least tens of thousands of years The presence of these soils on Mesita del Buey suggests very low erosion rates under undisturbed conditions, although detailed studies of soil genesis necessary to confirm this have not been conducted on the Pajarito Plateau. Intermixed with the Hackroy soils on the mesa tops are small areas of deeper loams of the Nyjack series and patches of bedrock. The Nyjack soils are texturally similar to Hackroy soils, and Nyjack soils are distinguished by thicknesses of 8 to 40 in. and by the common presence of pumice fragments in the lower soil (Nyhan et al. 1978, 0161). Areas of rock exposure are common towards the edges of the mesa.

The slopes between the mesa top and canyon bottoms consist of steep rock outcrops and patches of shallow, undeveloped colluvial soils (Nyhan et al. 1978, 0161). The south-facing canyon walls of Pajarito Canyon are steep and have little or no soil material or vegetation, whereas the north-facing walls of Canada del Buey have areas of thin dark-colored soils. The characteristics and distribution of these soils suggests faster erosion rates of surficial material on the south-facing canyon walls than the north-facing walls under the present vegetation and climate, although detailed studies of spatial variations in erosion are not available to confirm this.

The canyon bottoms north and south of Mesita del Buey are underlain by thick, poorly-developed, well-drained soils of the Totavi series formed in alluvium (Nyhan et al. 1978, 0161). Alluvium penetrated by drill holes is up to 30 ft thick in the center of Pajarito Canyon south of TA-54, and is up to 12 ft thick in Canada del Buey north of TA-54 (John et al. 1966, 0708; Devaurs 1985, 0046).

3.4 Hydrologic Setting

3.4.1 Surface Water

Runoff and infiltration of surface water are significant aspects of surface water hydrology on Mesita del Buey, providing mechanisms by which contaminants can be potentially mobilized and transported through the environment. Runoff may carry contaminants into drainage channels, and then transport and deposit them downstream. Infiltration of surface water is the source of subsurface moisture which can potentially transport contaminants underground.

Surface runoff occurs on Mesita del Buey and in small drainages off the mesa for brief periods during spring snowmelt and intense summer thunderstorms. A gauging station was constructed on a small drainage on Mesita del Buey at MDA G (Figure 3.4-1) to determine rainfall-runoff relations for a representative part of the mesa, and to measure the concentrations of contaminants transported in the runoff. Small amounts of plutonium were detected in both the runoff and in the suspended sediments, documenting transport of contaminants from MDA G, although the quantities measured were below levels of regulatory concern (Abeele et al. 1981, 0009; Purtymun et al. 1983, 08-0014).

Runoff from summer storms on the Pajarito Plateau reaches a maximum discharge in less than two h, and has a duration generally less than 24 h. High discharge rates can transport large masses of suspended and bed sediments for long distances down the canyons. Spring snowmelt runoff occurs over a period of several weeks to several months at a low discharge rate. Although the long duration of snowmelt runoff results in the movement of significant masses of suspended and bed sediments, the mass transported seems to be less than that carried by summer runoff events (Purtymun et al. 1990, 0215).

Stream flow is ephemeral in Canada del Buey and Pajarito Canyon north and south of Mesita del Buey, respectively, and also occurs during snowmelt or thunderstorms (Purtymun and Kennedy 1971, 0200; Devaurs and Purtymun 1985, 0049). Southwest of Mesita del Buey near White Rock, Pajarito Canyon has some intermittent return flow at seasonal springs, where alluvium pinches out onto the underlying basalt (Purtymun and Kennedy 1971, 0200).

3.4.2 Alluvial Aquifers

IWP Section 2.6.4, "Geohydrology of Canyon Surface Waters and Alluvial Aquifers," discusses alluvial aquifers in the canyons of the Pajarito Plateau on a canyon-by-canyon basis. These perched aquifers in alluvial fills of the canyon bottoms are created and maintained by recharge from surface channels. Water moves downward through the alluvium until it is impeded by the less permeable tuff. Depletion by evapotranspiration and movement into the underlying rock limits the size of the alluvial aquifers. These aquifers are of interest because of the following issues:

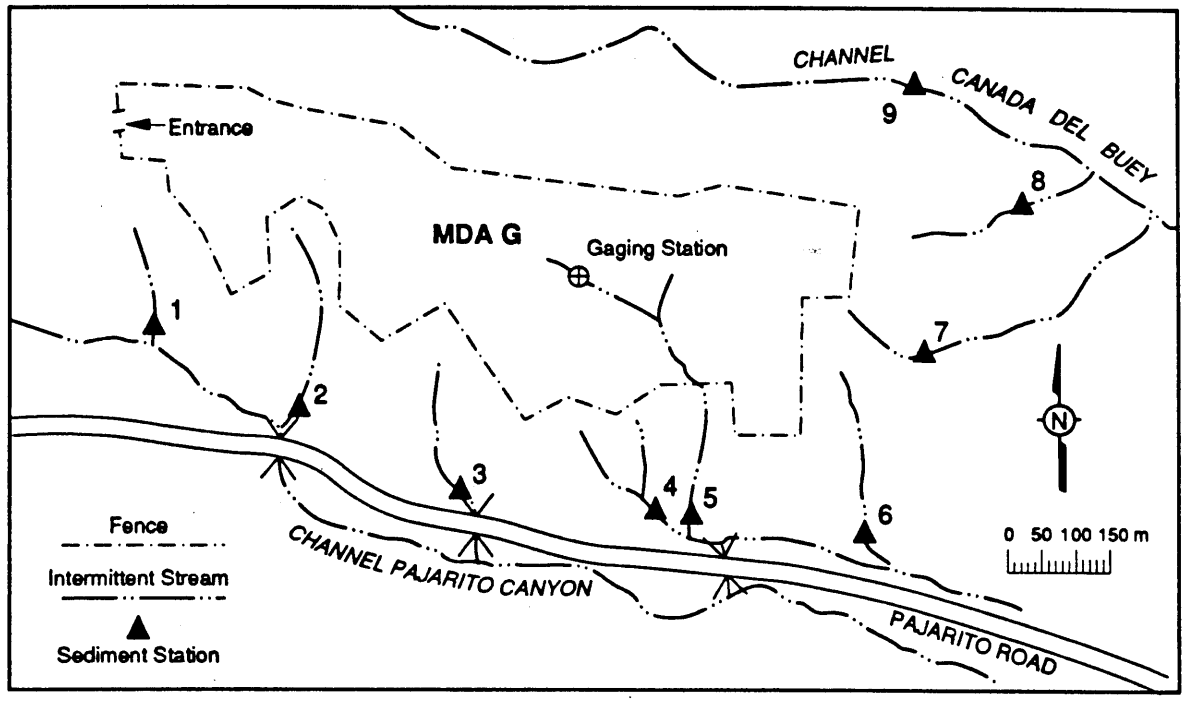


Figure 3.4-1 Location of sampling locations used by the LANL EM-13 Environmental Surveillance Program to monitor surface runoff at TA-54 (LANL, 1990, XXXX).

- contaminated surface water recharging an alluvial aquifer may be stored in the canyon system and be available for uptake by biota; and

- water from the alluvial aquifers can percolate into the underlying tuff and potentially move toward the much deeper main aquifer.

A perennial aquifer occurs within the alluvium of Pajarito Canyon, perched on the Bandelier Tuff and recharged by the intermittent stream. The water table of this perched aquifer is highest during the spring snowmelt period and late summer thunderstorm season, and declines in early summer and fall (Purtymun and Kennedy 1971, 0200). A perched aquifer is not known to occur in the alluvium of Canada del Buey. No perched aquifer was found in four test holes drilled in spring 1985 (Devaurs and Purtymun 1985, 0049).

Based on three test holes drilled in 1985 along the north edge of Pajarito Canyon, and many additional holes drilled into the Bandelier Tuff beneath Mesita del Buey, there is no evidence that the perched aquifer in Pajarito Canyon extends horizontally beneath Mesita del Buey (Devaurs and Purtymun 1985, 0049).

Based on studies in Mortandad Canyon to the north, which discovered that water from an alluvial aquifer infiltrated the underlying Bandelier Tuff, water from the perched aquifer in Pajarito Canyon may have also infiltrated into the underlying substrate, although the amount of this infiltration is difficult to estimate and may be minor. Possible infiltration of water from the alluvial aquifer in Pajarito Canyon into the underlying substrate is also suggested by the observations of Purtymun and Kennedy. Although the alluvial aquifer in the vicinity of TA-54 is perennial, return flow downstream where the alluvium pinches out is intermittent (Purtymun and Kennedy 1971, 0200). Infiltration may be through fractures in the basalt in that part of the canyon where the stream has eroded most or all of the Bandelier Tuff.

If a significant amount of water from the alluvial aquifer in Pajarito Canyon infiltrates the underlying rock units, it may produce perched aquifers within the Cerros del Rio basalts or within the Puye Formation. Such perched aquifers exist to the north in lower Los Alamos and Pueblo Canyons, as described in IWP Section 2.6.5, "Perched Water". Perched aquifers in the bedrock are not evident in water-supply wells PM-2, PM-4, or PM-5 near Mesita del Buey, where over 400 ft of tuff occur between the canyon bottom and the Cerros del Rio basalts. To the east, in the vicinity of MDA L and MDA G where the thickness of tuff is much less, no data are available to determine the presence or absence of perched aquifers.

3.4.3 Vadose Zone

The vadose zone, or unsaturated zone, consists of that part of the subsurface above the water table, where pore spaces and fractures are not saturated with water. The hydrology of the vadose zone of the Pajarito Plateau is discussed in IWP Section 2.6.3, "Geohydrology of Mesa Tops and Vadose Zone". It includes discussions concerning the hydrogeologic properties of the tuff and the movement of fluids through the tuff, and describes related studies that have been conducted at the

Laboratory. The summary of the studies strongly supports the concept that the unsaturated zone of the Bandelier Tuff provides substantial impedance to the movement of liquid in the subsurface.

No perched water has been encountered in drill holes to maximum depths of 300 ft beneath Mesita del Buey, and the vadose zone here may be 850-1100 ft. Contaminant transport in the vadose zone can be either liquid-phase or vapor-phase, although only vapor-phase transport has been identified at TA-54. Detailed understanding of the vadose zone at TA-54 and TA-51 is important because it is believed to be the primary barrier to the movement of liquids and vapors originating from the SWMUs. Features of the vadose zone that are important to migration of contaminants include

- physical properties of the Bandelier Tuff (density, porosity);
- geohydrologic properties of the tuff (such as air and water permeabilities and conductivities, and moisture characteristic curves);
- frequency, orientation, and filling material of joints and fractures; degree of interconnectedness of open joints and fractures; flow paths (surge beds) or barriers at unit contacts; and
- geochemical properties of the tuff related to water, air, or contaminant transport (specific surface, ion exchange capacity, K_d, and mineralogy).

Field permeability tests have been conducted in five boreholes at MDA G and MDA L to determine the permeability and hydraulic conductivity of the Bandelier Tuff (Kearl et al. 1986, 0135; IT Corporation 1987, 0327). These tests included air injection, water injection, and air vacuum methods. The air injection method produced the most data, which consisted of 25 6 ft intervals in the five holes, and included seven intervals adjacent to fracture zones. The highest hydraulic conductivity of 9.3×10^{-5} ft/s was measured along a fractured zone, and the average conductivity at fractured intervals of 3.1×10^{-5} ft/s was a factor of two greater than the average conductivity for unfractured intervals. Measurements obtained in one of the holes with a water injection test supported the general accuracy of the air injection measurements. Data from the air vacuum method consisted of 21 intervals in the five boreholes, including three intervals along fractured zones. Although no difference in permeability was seen between the fractured and unfractured intervals, the air vacuum method was not effective in the more permeable portions of tuff, biasing the data to lower permeability zones. All methods showed a general decrease in permeability with depth in the tuff (Kearl et al. 1986, 0135; IT Corporation 1987, 0327).

Moisture content of the Bandelier Tuff beneath Mesita del Buey, as measured in core segments from 12 drill holes, is generally very low. Volumetric moisture content in the upper 100 ft of tuff is typically 2-4%, with higher moisture contents in certain stratigraphic layers and in some fractured intervals. Relatively high moisture contents, up to 26%, were measured in Unit 1b beneath Mesita del Buey (Figure 3.4-2). The source of this higher moisture content at depth has not been identified.

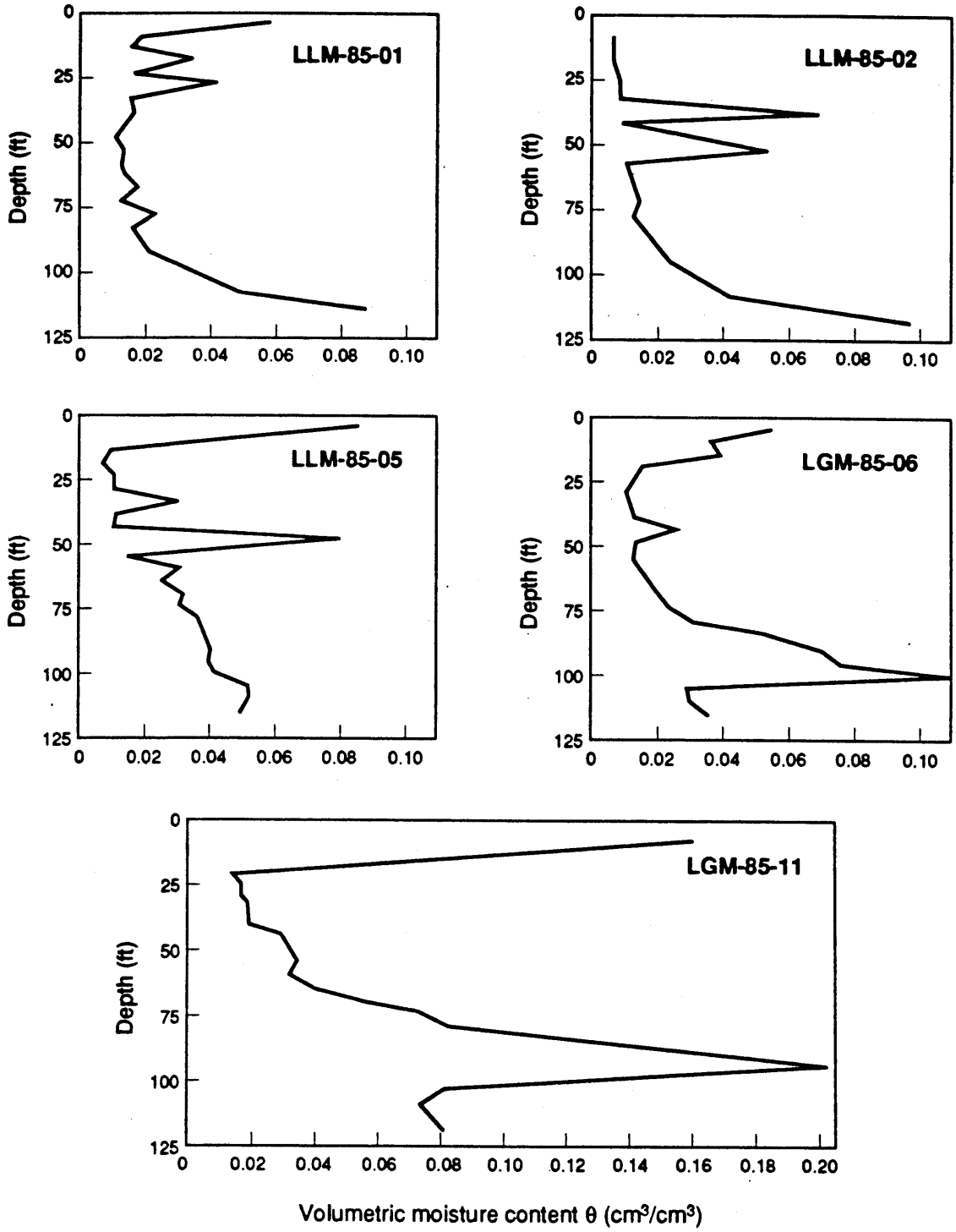


Figure 3.4-2 Volumetric moisture profiles of bandelier tuff from selected borings in TA-54 MDA G and L (BFEC 1986; IT 1987).

Moisture-retention in the tuff is extremely high, up to 80%, and is equivalent to a volumetric moisture content of about 60%. Liquid-phase transport in the vadose zone cannot occur unless this moisture content is exceeded (Kearl et al. 1986, 0135).

A vadose zone moisture monitoring program consisting of neutron moisture probe logging in a borehole in MDA G and MDA L was conducted at TA-54 in 1985. Volumetric moisture content remained low, about 2-5%, at depths greater than 10-15 ft, indicating little infiltration of precipitation below this depth in the monitored holes. Slight changes in moisture content were recorded to depths of about 10 ft and were associated with three storms in 1986 (IT Corporation 1987, 0327). These data from TA-54 are consistent with earlier neutron-moisture studies in the Bandelier Tuff reported by Abeele et al. (Abeele et al. 1981, 0009). Observations of fractures exposed in pits and intersected by drill holes provide evidence that water has infiltrated to greater depths along some discrete fractures than the depth of infiltration measured in the boreholes logged with neutron moisture probes.

Infiltration of water through the soil, and flow along fractures during heavy rainfall is documented by observations of water emerging from fractures in Pit 7 at MDA G during a heavy rainfall in September 1973 (Rogers 1977, 0216). Roots have been observed extending along fractures to the base of Pits 7 and 24 at MDA G, 25-30 ft deep, and are partially associated with fresh watermarks on the fractures (Rogers 1977, 0216). In addition, roots have also been observed to depths of 41 ft in drill hole LLC-85-12 (Kearl et al. 1986, 0135). At TA-49, roots have been recorded in shafts 2-V and 2-W to depths of 58 ft (Weir and Purtymun 1962, 0228). Deposits and alteration along fractures also document downward transport of water. Calcium carbonate (caliche), precipitated by water, has been observed on fractures to depths of 27.7 ft in drill hole LLM-85-02 (Kearl et al. 1986, 0135), and at depths of about 39 ft in horizontal drill hole P-3 MH-2 beneath Pit 3 at MDA G (Purtymun et al. 1978, 0207). Brown clay coated 72% of the fractures intersected by the horizontal drill holes beneath Pit 3, including fractures in the upper part of Unit 2a, and occurred about 46 ft below the ground surface (Purtymun et al. 1978, 0207). The significance of these indicators of liquid-phase transport in the vadose zone has not been quantitatively evaluated. However, the historical record of observations on discrete fractures indicates that liquid phase transport in the vadose zone is generally restricted to depths of less than 50 ft.

3.4.4 Main Aquifer

The top of the main aquifer beneath Mesita del Buey is within either the Puye Formation conglomerates or the interbedded and overlying basalts of the Cerros del Rio volcanic field. The top of the main aquifer is about 1100 ft beneath TA-51 to the west and about 850 ft beneath MDA G to the east. The flow rate of groundwater in the main aquifer in the vicinity of Mesita del Buey was calculated as 95 ft/yr (0.26 ft/day) by Purtymun (Purtymun 1984, 0196).

The primary recharge for the main aquifer was originally thought to be from small streams on the western flank of the Sierra de los Valles and the western part of the Pajarito Plateau (Griggs and Hem 1964, 0313; Cushman 1965, 0042). Subsequent studies have suggested that recharge is instead in the Valles caldera to the west

(e.g., Purtymun and Johansen 1974, 0199; Abeele et al. 1981, 0009; Purtymun 1984, 0196). More recently, isotopic analyses of water from the main aquifer indicate that major recharge from the Valles caldera is unlikely, with the isotopic signature instead supporting recharge west of the crest of the Sierra de los Valles (Goff 1991, 08-0016). Recharge to the main aquifer from alluvial aquifers remains a possibility. In contrast, due to the great thickness of unsaturated tuff underlying the mesas, recharge to the main aquifer from infiltration from the mesa tops is unlikely.

3.5 Geology

3.5.1 Introduction

An overview of the geologic setting of the Laboratory is presented in IWP Section 2.6.2. Knowledge of the geology beneath Mesita del Buey is important because it is believed that this geologic setting provides substantial impedance to contaminant migration. Geological aspects of interest include

- the detailed stratigraphy of the upper units of the Bandelier Tuff, including contacts between units that may form barriers to migration or create paths to divert liquid or vapor movement;
- joints in the Bandelier Tuff that may provide paths for liquid and vapor movement;
- the mineralogy of the geologic strata that may be important in the retardation of contaminant movement;
- faulting that may provide zones of fracturing along which contaminant transport may be enhanced; and
- processes of surficial erosion that could potentially transport contaminants.

3.5.2 Bedrock Stratigraphy

Mesita del Buey is capped by the Bandelier Tuff of Pleistocene age, which is exposed in the canyon walls and is penetrated by numerous drill holes (Figures 3.5-1 and 3.5-2). Beneath the Bandelier Tuff, a sequence of interstratified sedimentary and volcanic rocks of Miocene to Pleistocene age occur which have been penetrated by water-supply wells and which have been studied where they outcrop in canyons on the margins of the Pajarito Plateau. In the vicinity of Mesita del Buey, water-supply wells PM-2, PM-4, and PM-5 (Figures 3.5-1 and 3.5-3) extend to depths from 2600 to 3120 ft and penetrate Pliocene-to-Pleistocene basaltic rocks of the Cerros del Rio volcanic field; Pliocene-to-Pleistocene sedimentary rocks of the Puye Formation; Pliocene sedimentary rocks of the Totavi Lentil; and Miocene-to-Pliocene sedimentary rocks of the Santa Fe Group and associated basalts. These formations are

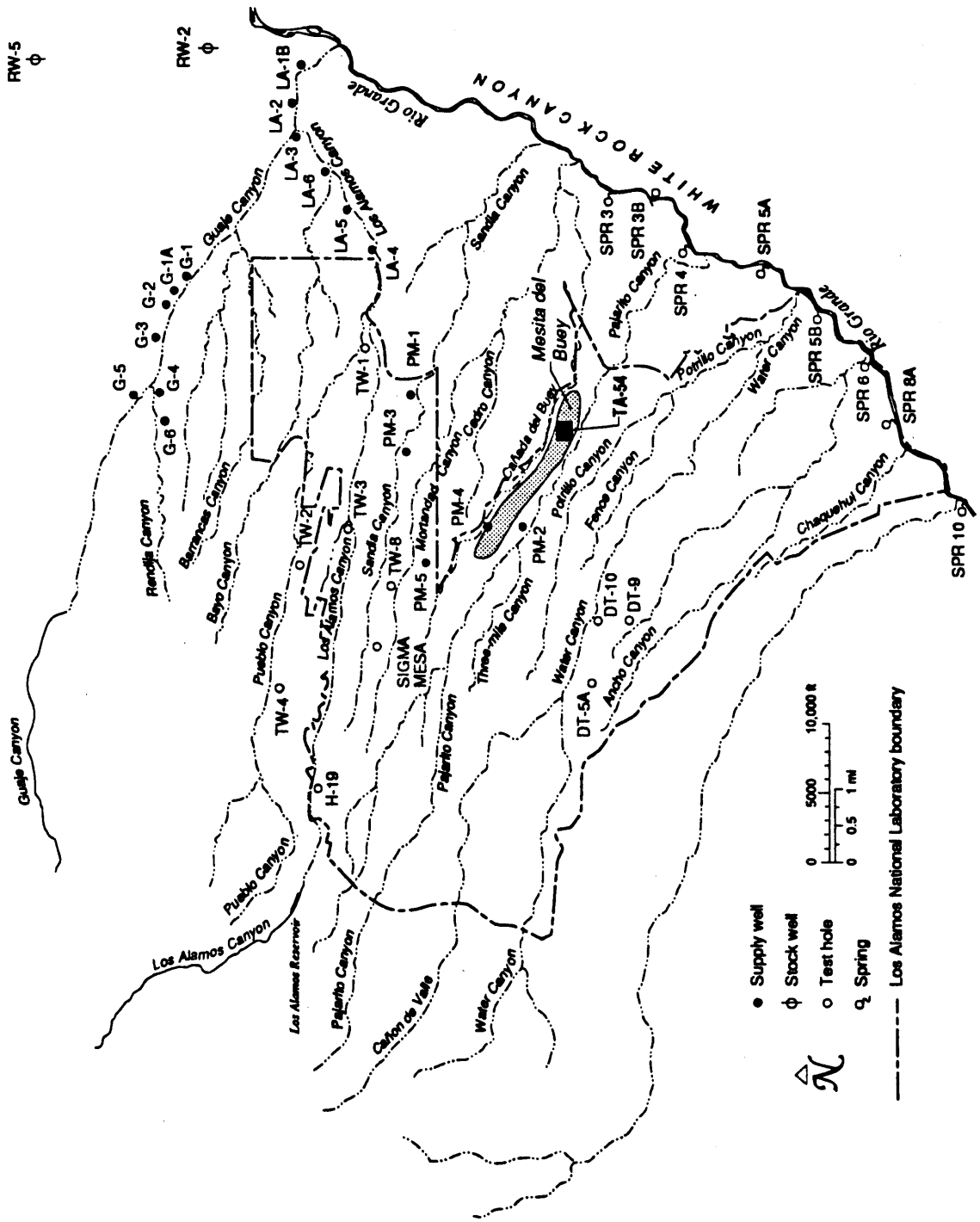


Figure 3.5-1 Map of water-supply wells in the vicinity of Mesita del Buey (Purtymun et al. 1984 LA-9957-MS).

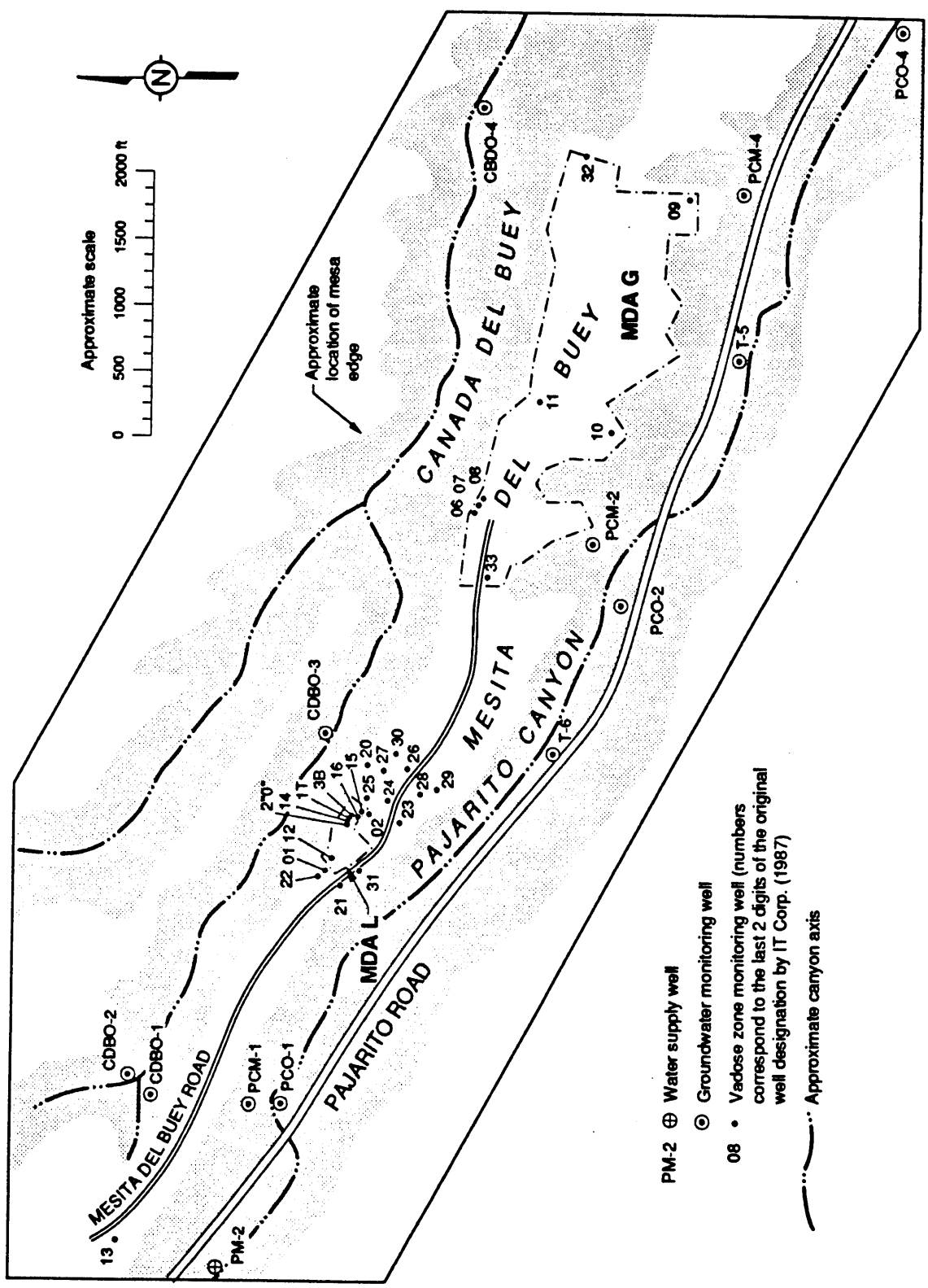


Figure 3.5-2 Map of instrumented boreholes, test holes, and monitoring wells at MDA G and MDA L, TA-54 (IT Corp. 1987; LANL 1985 [ENG. 54-46]).

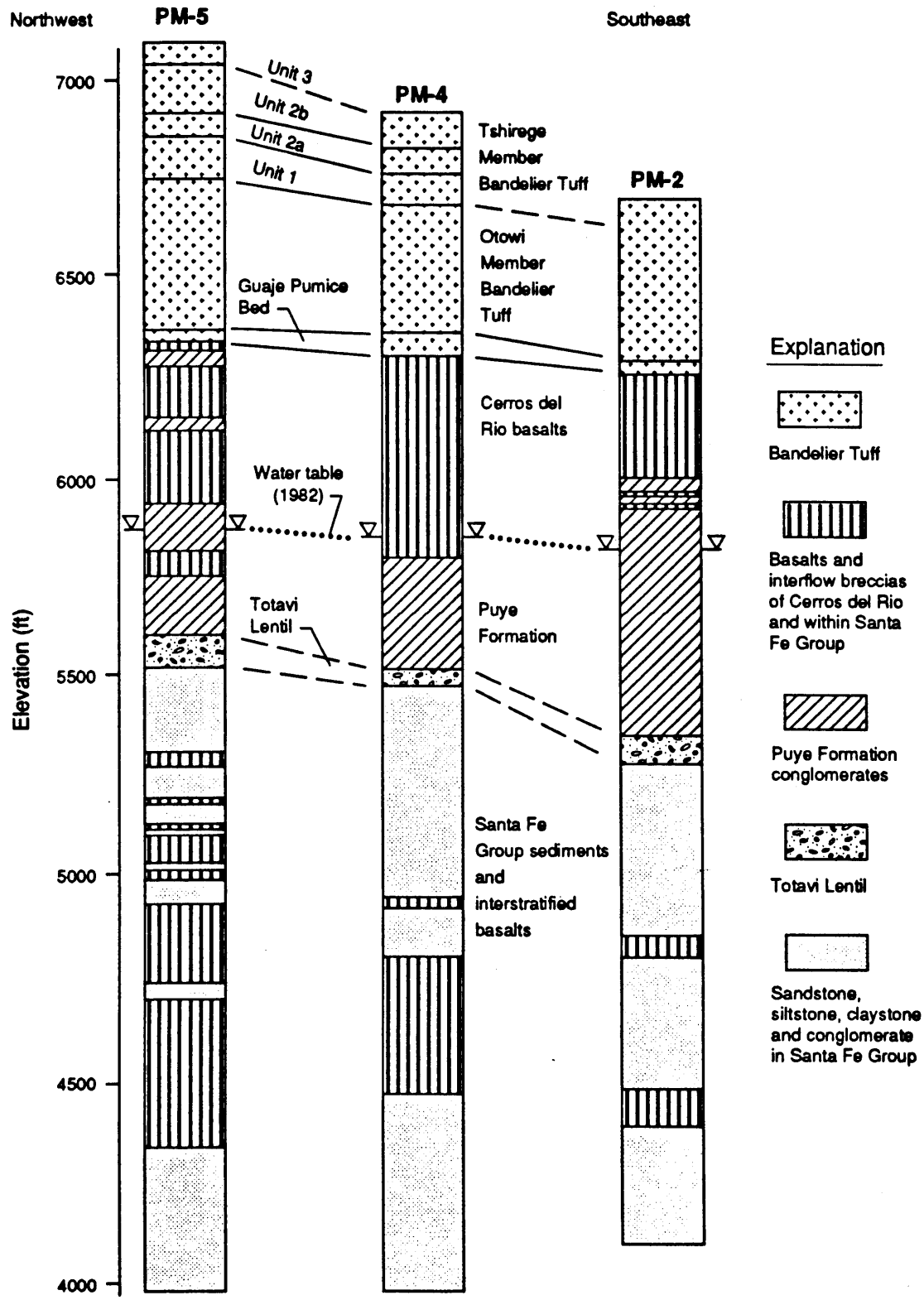


Figure 3.5-3 Lithologic logs for water-supply wells drilled near Mesita del Buey (from Cooper et al. 1965; Purtymun et al. 1983a, 1984).

briefly discussed below, from youngest to oldest (e.g., from top to bottom). Additional general discussion is presented in IWP Section 2.6.2.2.

3.5.2.1 Tshirege Member, Bandelier Tuff

The uppermost rock unit at Mesita del Buey is the Tshirege Member of the Bandelier Tuff which erupted from the Valles caldera to the west (Smith and Bailey 1966, 0377). Disposal units at TA-54 were all constructed within the Tshirege Member, following recommendations from the U.S. Geological Survey in 1956 (Rogers 1977, 0216).

The Tshirege Member is composed of multiple flow units of crystal-rich ash-flow tuff, and displays significant variations in welding and alteration both in a single stratigraphic section and at varying distances from the caldera. Individual units tend to be more welded and thicker to the west. Flow unit boundaries are locally separated by volcanic surge deposits of well-sorted, fine-grained, cross-bedded crystal and pumice fragments. Vapor-phase alteration, caused by post-emplacement cooling and migration of entrained magmatic gases, occurs in the upper flow units. The base of the Tshirege Member consists of 1.5 to 10 ft of bedded, unconsolidated, pumice-rich ashfall tuff of the Tsankawi Pumice Bed (Crowe et al. 1978, 0041). The Tsankawi Pumice Bed is not exposed in outcrop at Mesita del Buey, and is generally poorly recognized in drill bit cuttings because rotary drills commonly grind the soft materials into dust.

The Tshirege Member has been subdivided into a sequence of mappable units based on either erosional characteristics (Baltz et al. 1963, 0024; Purtymun and Kennedy 1971, 0200), or on primary cooling units (Crowe et al. 1978, 0041). Following the unit designations of Baltz et al. (Baltz et al. 1963, 0024), Unit 2b is the resistant unit that caps Mesita del Buey at TA-54 (Figures 3.5-4 and 3.5-5) (Purtymun and Kennedy 1971, 0200). Unit 3 caps the mesa at TA-51 to the west. As described by Crowe et al. (Crowe et al. 1978, 0041), Unit 2b is the more-welded portion of Cooling Unit 2, and the mesa-capping part of Unit 3 is the more-welded part of Cooling Unit 3. Correlations of these units are shown in Figure 3.5-6. The boundaries between the units based on erosional resistance are not always distinct in the field, and can be difficult to recognize in drill holes, causing unit assignments that vary between workers. For example, the boundary between Unit 1b and Unit 2a assigned in the 1985 drilling program by Bendix (Kearl et al. 1986, 0135; IT Corporation 1987, 0327), is within the Unit 2a of Purtymun and Kennedy (Purtymun and Kennedy 1971, 0200).

The base of Unit 2b at Mesita del Buey (the base of Cooling Unit 2 of Crowe et al. 1978, 0041) includes well-sorted, cross-bedded volcanic surge deposits (Figures 3.5-4 and 3.5-6) that may provide a preferential lateral migration pathway for contaminants (Crowe et al. 1978, 0041). Purtymun (Purtymun 1973, 0191) noted increased rates of vapor-phase migration of tritium away from storage shafts at TA-54 along this layer. Additional stratigraphic layers that could provide preferred pathways for contaminant migration may exist elsewhere within the Tshirege Member (Crowe et al. 1978, 0041). Units within the Tshirege Member dip to the southeast at Mesita del Buey (Figure 3.5-4) (Purtymun and Kennedy 1971, 0200),

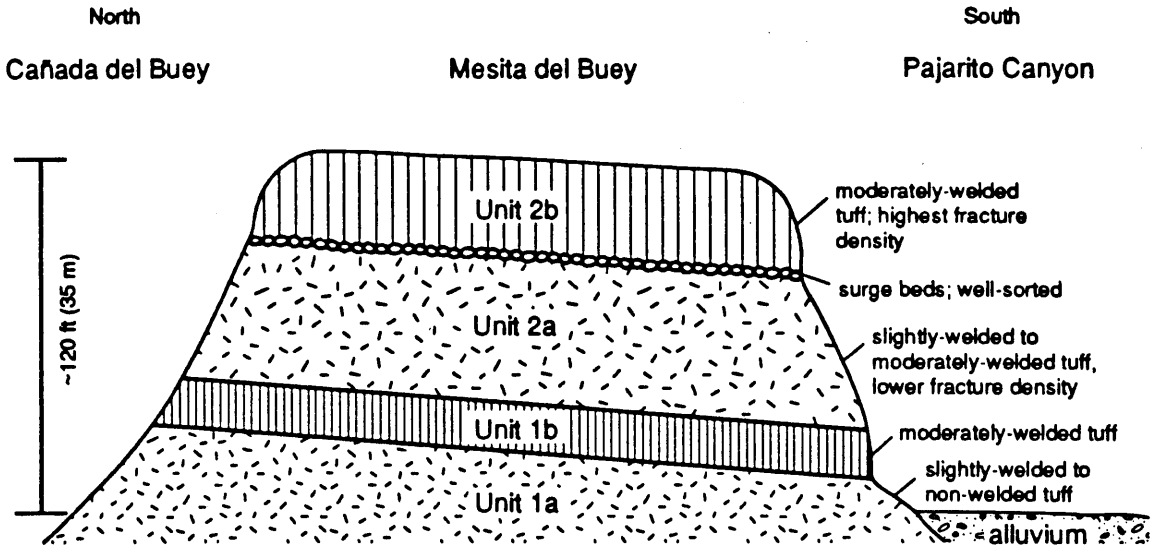


Figure 3.5-4 Schematic geologic cross section of eastern part of Mesita del Buey. (Geologic units from Purtymun and Kennedy (1971). Vertical scale and dip of beds exaggerated.)

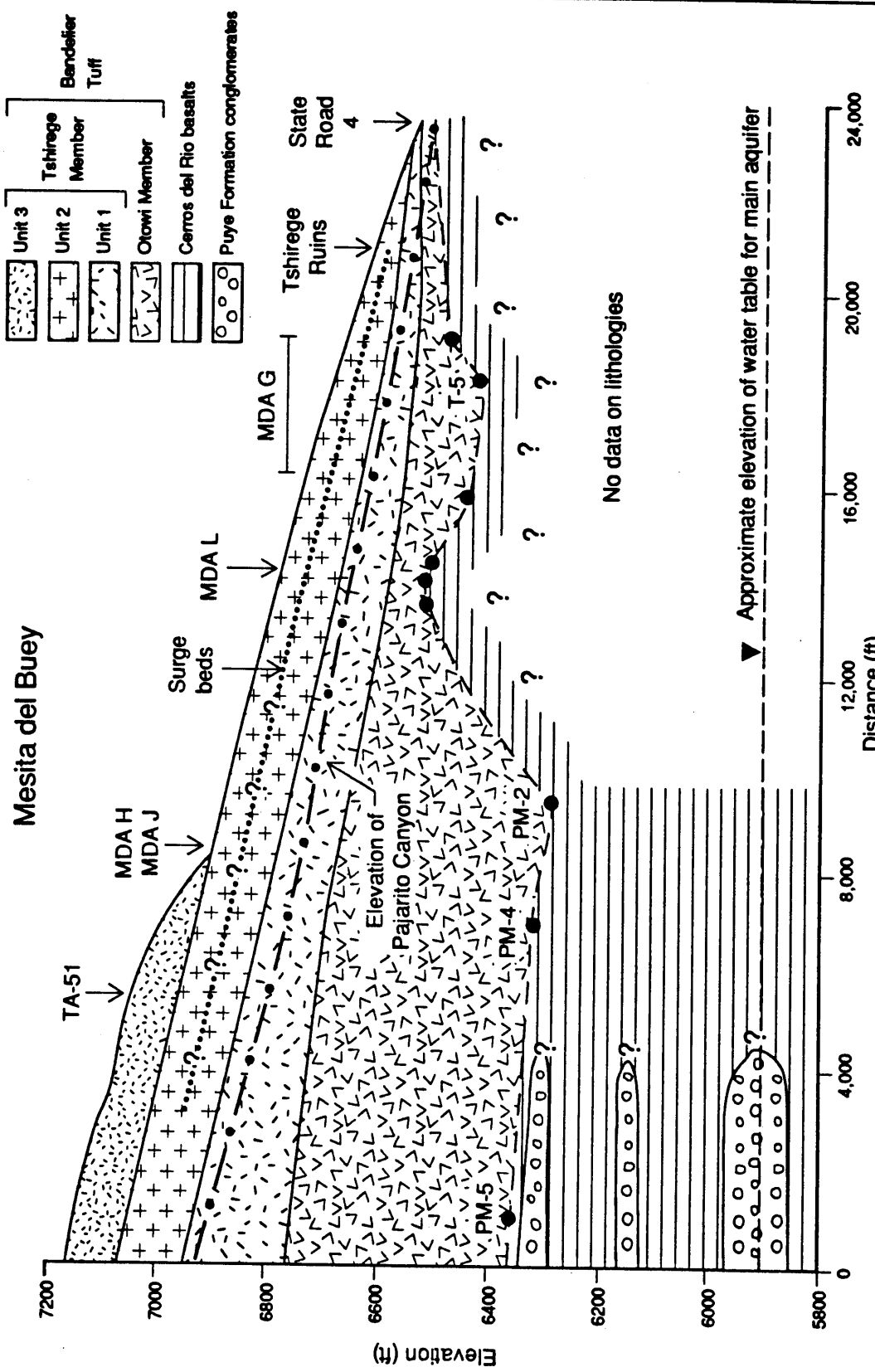


Figure 3.5-5 Profile of Mesita del Buey showing top of mesa, elevation of floor of Pajarito Canyon, and subsurface geologicunits and elevation of water table in main aquifer.

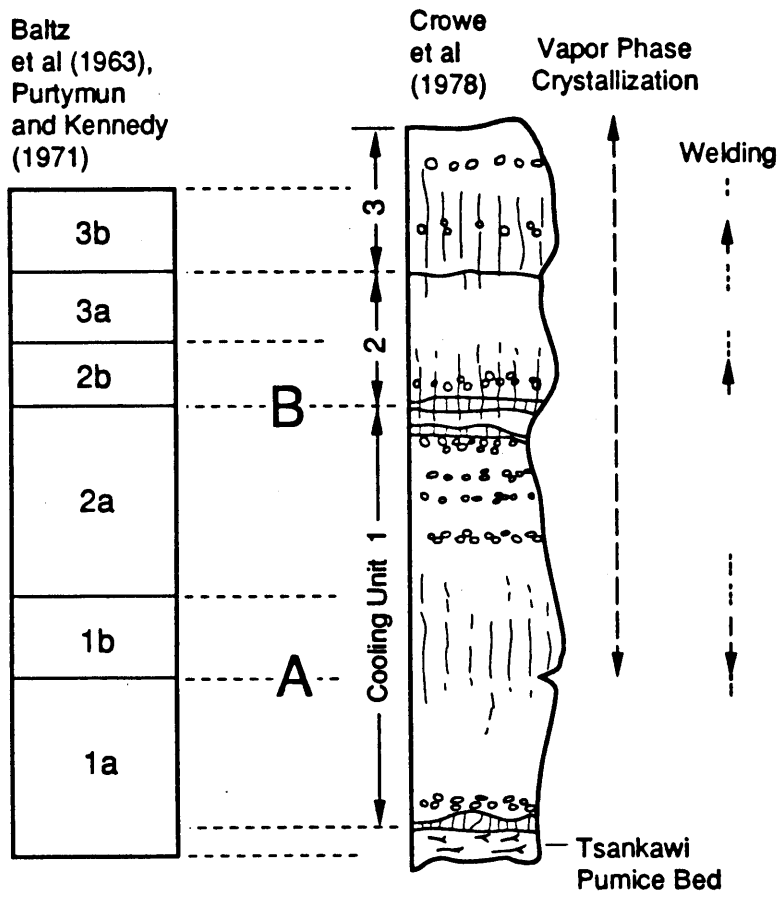


Figure 3.5-6 Approximate correlation of units within the Tshirege Member of the Bandelier Tuff. (Diagram on the right is modified from Fig. 4 of Crowe et al. (1978), and shows primary depositional features and secondary features of the Tshirege Member. Symbols represent, from bottom to top of column: (1) Y-shaped shards—air-fall pumice deposits; (2) lenticular, cross-hatched zones—pyroclastic surge deposits; (3) unfilled ellipses—pumice swarms; (4) vertical lines—zones of columnar jointing in more welded zones. "A" refers to distinctive erosional notch in cliffs at level where vapor phase crystallization begins. "B" refers to distinctive contact at base of cooling unit 2, commonly recognizable in outcrop by presence of surge beds and pumice swarms.)

and vapor-phase transport along stratigraphic layers could potentially reach the south canyon walls.

Individual flow units within the Tshirege Member contain vertical cooling joints that may or may not cross flow unit boundaries. In ash-flow tuffs, cooling joint spacing varies primarily with thickness of the unit, emplacement temperature, substrate temperature, and topography. Joint density tends to be greatest in welded tuff and least in nonwelded tuff. Hydraulic conductivities are also generally greatest in the fractured, welded parts of ash-flow tuffs and least in the nonwelded parts (Crowe et al. 1978, 0041). A measured increase in moisture content in the more welded part of Cooling Unit 1 (Unit 1b; Figure 3.4-2) (Kearl et al. 1986, 0135; IT Corporation 1987, 0327) may be associated with an increase in fracture density in that unit as compared to the overlying nonwelded tuff.

Within the upper unit of the Tshirege Member at TA-54, joint spacing in the pits averages about 6-7 ft (Purtymun and Kennedy 1971, 0200; Rogers 1977, 0216). Joint spacing as measured in horizontally-drilled cores at MDA G is somewhat less, probably because minor joints that were not readily visible in the pits broke open in the cores (Purtymun et al. 1978, 0207). Cliff retreat at Mesita del Buey is caused by the detachment of blocks bounded by joints, which provide a potential pathway for liquid-phase and vapor-phase transport in the subsurface. Water movement along these joints is evidenced by the occurrence of precipitated calcium carbonate and translocated clays and the observation of water marks (Rogers 1977, 0216).

3.5.2.2 Otowi Member, Bandelier Tuff

The Otowi Member of the Bandelier Tuff underlies the Tshirege Member in the subsurface beneath Mesita del Buey. The Otowi Member is a non-welded vitric ashflow tuff that is composed of multiple flow units. It is highly porous and poorly indurated. Where it outcrops, cooling joints are typically absent because of the lack of induration. Beneath Mesita del Buey, the Otowi Member thins to the southeast, decreasing from an estimated thickness of about 700 ft in the vicinity of TA-51 (water-supply wells PM-4 and PM-5, Purtymun et al. 1983, 0712, 1984, 0713) and pinching out near White Rock (Figures 3.5-3 and 3.5-5). Beneath MDA L, the Otowi Member is about 80 ft thick. The Guaje Pumice Bed forms the base of the Otowi Member and consists of unsorted pumice fragments that average 0.8-1.6 in. in size (Crowe et al. 1978, 0041). The Guaje Pumice Bed is 10 to 60 ft thick in drill holes near Mesita del Buey (Cooper et al. 1965, 0495; Purtymun et al. 1983a, 0712, 1984, 0713).

3.5.2.3 Surge Beds of the Bandelier Tuff

The surge beds of the Bandelier Tuff are non-welded, pyroclastic beds containing tuff fragments and pumice fragments. The surge beds probably have a significantly higher lateral permeability than the over- and underlying tuff (Figures 3.5-4 and 3.5-5). Of particular interest are the surge beds at the contact point between tuff units 2a and 2b beneath MDA L at TA-54 (Figures 3.5-4 and 3.5-7). Disposal shafts at MDA L penetrate the surge beds which provide a potential lateral migration pathway

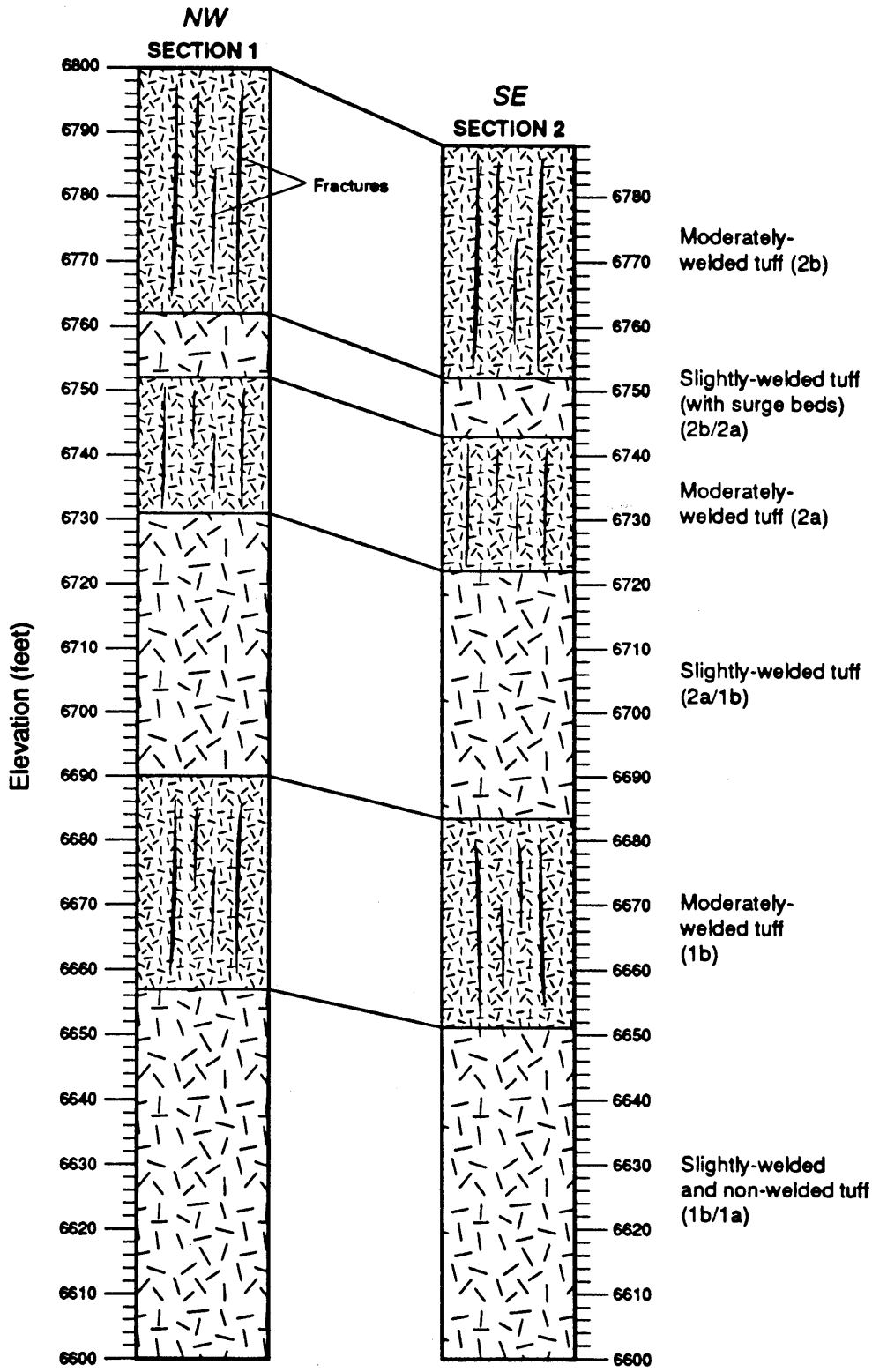


Figure 3.5-7 Generic geologic sections showing variation in welding location of surge beds in Tshirege Member of Bandelier Tuff at MDA L, TA-54. Units thin to the southeast.

for vapor phase contaminants. The over- and underlying tuffs are vertically fractured which could allow the vertical migration of contaminants to and from the surge beds. As a result, volatile contaminants could migrate downward from waste disposal pits to the surge beds where lateral migration can occur. Vapor phase contaminants released to the surge beds through disposal shafts, such as those at MDA L, may also migrate laterally and then, depending on the density of the vapor, move up or down through vertical fractures in the surrounding tuff. A tritium migration study performed by Purtymun (Purtymun 1973, 0710) at MDA G showed enhanced lateral migration of vapor phase tritium along the surge beds compared to the surrounding tuff.

3.5.2.4 Basaltic Rocks of Cerros Del Rio Volcanic Field

Basaltic to andesitic flows, breccias, and scoria associated with the Cerros del Rio volcanic field, centered east of the Rio Grande, interfinger with the Puye Formation in the subsurface beneath Mesita del Buey. These rocks also outcrop beneath the Bandelier Tuff adjacent to the eastern end of Mesita del Buey in Pajarito Canyon and Canada del Buey near White Rock (Griggs and Hem 1964, 0313). Immediately beneath the Bandelier Tuff, 268 ft of basaltic rock was penetrated in water-supply well PM-2, and 500 ft was penetrated at PM-4 (Figure 3.5-3) (Cooper et al. 1965, 0495; Purtymun et al. 1983, 0712). Many separate flows were noted in the drill hole logs, often separated by interflow breccias. To the west, the basalt flows are interstratified with the Puye Formation at water-supply well PM-5 (Figure 3.5-3) (Purtymun et al. 1984, 0713). Locally, as at water supply well PM-4, the top of the main aquifer is within the Cerros del Rio basalts.

3.5.2.5 Puye Formation

The Puye Formation consists of a lithologically variable fanglomerate that was shed from the Jemez Mountains volcanic center. The beds include stream flow deposits, debris flow deposits, volcanic ash and block flow deposits, and ash fall and pumice fall deposits (Waresback and Turbeville 1990, 0543). The Puye Formation is 710 ft thick at water-supply well PM-2, and 280 ft thick at well PM-4, including minor interstratified basalt (Figure 3.5-3). Further west, at well PM-5, Puye conglomerates and Cerros del Rio basalts are interstratified through 730 ft of section, with the conglomerates dominant in the lower half of the section and the basalts dominant in the upper half (Figure 3.5-3). In drill holes near Mesita del Buey, basaltic rocks typically overlie the uppermost Puye conglomerates. However, locally, as at test well T-6 in Pajarito Canyon, the Puye directly underlies the Bandelier Tuff (John et al. 1966, 0708) (Figure 3.5-5). The upper part of the main aquifer is generally within the Puye Formation.

3.5.2.6 Totavi Lentil

The Totavi Lentil is a coarse, poorly consolidated conglomerate that occurs at the base of the Puye Formation and overlies the Santa Fe Group. The Totavi Lentil probably represents ancestral Rio Grande channel gravels. In water-supply wells PM-2, PM-4, and PM-5, the Totavi Lentil is 40 to 80 ft thick, and occurs at lower elevations in the eastern wells (Cooper et al. 1965, 0495; Purtymun et al. 1983, 0712, 1984, 0713) (Figure 3.5-3).

3.5.2.7 Santa Fe Group

Rocks of the Santa Fe Group consist predominantly of fluvial sandstone, siltstone, and conglomerate with subordinate eolian deposits, ash beds, and lacustrine rocks. These rocks are the most extensive units filling the Rio Grande rift, and comprise the main aquifer for Los Alamos. Beneath Mesita del Buey, the sedimentary rocks are interstratified with basaltic rocks. Water-supply wells PM-2, PM-4, and PM-5 penetrate about 1200 to 1600 ft of Santa Fe Group rocks, of which basalts and associated interflow breccias constitute about 15% to 45% of the total section (Cooper et al. 1965, 0495; Purtymun et al. 1983a, 0712, 1984, 0713) (Figure 3.5-3).

3.5.3 Structure

The tectonic setting of the Laboratory is summarized in Section 2.6.2.1 of the 1991 IWP. The most important tectonic feature is the Pajarito fault system which crosses the Pajarito Plateau. The fault system is composed of steeply-dipping normal faults, with some component of oblique offset, and has had Holocene movement and historic seismicity (Gardner and House 1987, 0110). The main trace of the Pajarito fault system displays major (about 300 ft) down-to-the-east offset of the Bandelier Tuff immediately west of the Laboratory. To the east, beneath the Laboratory, many additional faults have been recognized in the subsurface, with smaller amounts of primarily down-to-the-west displacement. Only two of these faults are known to have broken the surface of the Bandelier Tuff (Guaje Mountain and Rendija Canyon faults), and this offset is restricted to areas north of Los Alamos Canyon (Gardner and House 1987, 0110) (Figure 3.5-8). South of Los Alamos Canyon, movement on the Guaje Mountain and Rendija Canyon faults has produced broad zones of intense fracturing that are superimposed on the primary cooling joints. These faults may be propagating towards the surface. Fracture density in these zones increases from background levels of about one fracture every 5 ft to as high as one fracture every 2 ft (Vaniman and Wohletz 1990, 0541). In contrast to cooling joints, these tectonic fractures are more likely to cross flow-unit and lithologic-unit boundaries, and may provide more continuous and deeper penetrating flow paths for liquid or vapor phase migration than cooling joints.

Adequate subsurface data are not available to confidently determine the presence or absence of similar subsurface faults beneath Mesita del Buey, although a study by Dransfield and Gardner (Dransfield and Gardner 1985, 0082) suggests the presence of a fault between MDA L and MDAs H and J (Figure 3.5-8). In addition,

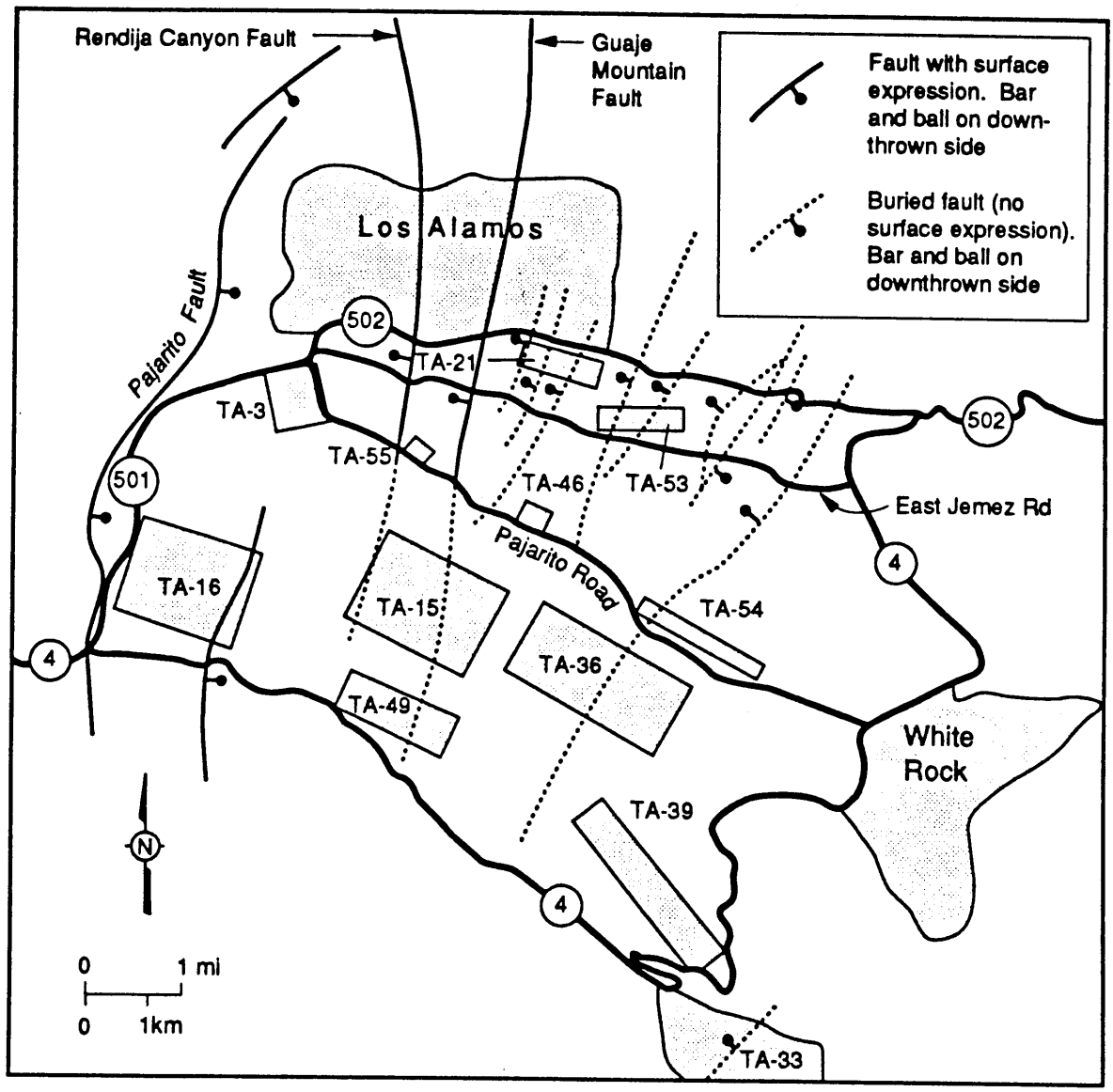


Figure 3.5-8 Map of known and suspected faults in the vicinity of the LANL (modified from Dransfield and Gardner 1985 and Gardner and House 1987).

down-to-the-northwest offsets of 2.8-3.5 in. were observed on three fractures exposed in Pit 22 at MDA G (Rogers 1977, 0216), which are similar to observations by Vaniman and Wohletz (Vaniman and Wohletz 1990, 0541) of tectonic fractures to the west, and suggesting the presence of a fault at depth. Because of the absence of recognizable surface offsets of the Bandelier Tuff at Mesita del Buey in the last 1.1 million years, the probability of surface rupture from faults during the period of concern for transuranic wastes (~10,000 yr) may be low, and the most significant potential effect of faulting may be in locally increasing the density and the opening of fractures.

3.5.4 Erosional Processes

Surface erosion could potentially result in the exposure or transport of contaminants on Mesita del Buey. Erosion of material on Mesita del Buey occurs primarily by shallow runoff on the relatively flat parts of the mesa, by deeper runoff in channels, and by rockfall and colluvial transport on the canyon walls. Wind erosion of disturbed soils also occurs.

Erosion rates of the Bandelier Tuff on the Pajarito Plateau are not known. Estimates of long-term vertical erosion rates on the mesa tops based on stripping of overlying units (Purtymun and Kennedy 1971, 0200) are of limited value in predicting the stability of waste sites because the resistant, cliff-forming units may be eroded primarily by lateral cliff retreat and not vertical erosion. Much spatial variability in erosion rates may also exist on the mesa tops, being greatest in and near drainage channels and in areas of locally steeper slope gradient, and least on relatively gently sloping portions of the mesa tops removed from channels.

No detailed studies of spatial variations in erosion and surface runoff have been conducted on the Pajarito Plateau, although some local data are available. A sampling station was constructed on Mesita del Buey at MDA G to determine rainfall-runoff relations and to provide a sediment sampling point for surficial material eroded off a representative part of the mesa. Additional sediment sampling stations have been established on channels draining Mesita del Buey adjacent to MDA G to measure the concentrations of contaminants in sediment eroded from the mesa (Figure 3.4-1) (Abeele et al. 1981, 0009; Purtymun et al. 1983, 08-0014). Additionally, rainfall simulation experiments have been used to measure erosion rates from experimental trench caps at TA-51, with the intent to designing trench covers for shallow land burial to minimize erosion rates (Nyhan et al. 1984, 0167).

On the canyon walls, erosion rates of surficial material may vary between the north and south sides of Mesita del Buey. Under the present vegetation and climate, erosion rates appear faster on the drier, less-vegetated south side of Mesita del Buey than on the wetter, more-vegetated north side. This is suggested by the more extensive exposure of bedrock on the south side and the greater soil cover on the north side. No measurements have been made to confirm these possible variations in erosion rates. However, it should be noted that the MDAs at TA-54 will be under institutional control and the integrity of the cliff face will be monitored and maintained.

3.6 Biology

3.6.1 Summary

During 1991, field surveys were conducted by the Biological Resource Evaluations Team of the Environmental Protection Group (EM-8) for OU 1148 (Site Characterization). Site Characterization requires surface and subsurface sampling within the operable unit. Further information concerning the biological field surveys for OU 1148 is contained in the full report "Biological Assessment for Environmental Restoration Program, Operable Unit 1148" (LANL 1992, 08-0040 in preparation). The Biological Assessment will contain specific information on survey methodology, results and mitigation measures. The assessment will also contain information that may aid in defining ecological pathways and vegetation restoration.

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

3.6.2 Methodology

The purpose of the field surveys was three-fold. The first goal was 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. Second, surveys were conducted to identify the presence or absence of any sensitive areas such as floodplains and wetlands that may be present within the areas to be sampled and the extent of the areas and general characteristics. The third purpose was to provide additional plant and wildlife data concerning the habitat types within the operable unit.

This data provides further baseline information about the biological components of the site for site characterization and determination of pre-sampling conditions. This information is also necessary to support the NEPA documentation and determine a categorical exclusion for the sampling plan for site characterization. Personnel at the operable unit propose to collect sediment samples and surface and subsurface soil samples. The sediment samples will be taken from existing sediment basins within canyons located in the operable unit. In some locations, trenching may be necessary to collect subsurface soil samples.

After searching the database 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 the Laboratory and surrounding areas, a habitat evaluation survey (Level 2) was conducted. A Level 2 survey is performed on areas that are not highly disturbed which could potentially support threatened and/or endangered species. Techniques used in a Level 2 survey are designed to gather data on the percent cover, density, and frequency of both the understory and overstory components of the plant community.

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

In each location, all wetlands and floodplains within the survey area were noted using National Wetland Inventory Maps and field checks. Characteristics of wetlands, floodplains, and riparian areas are noted using criteria outlined in the "Federal Manual for Identifying and Delineating Jurisdictional Wetlands" (1987).

3.6.3 Results

Database searches indicated that the species of concern for this operable unit were the

- peregrine falcon (*Falco peregrinus*-Federally Endangered);
- bald eagle (*Haliaeetus leuccephalus*-Federally Endangered);
- Common black hawk (*Buteogallus anthracinus*-State Endangered);
- Mississippi kite (*Ictinia mississippiensis*-State Endangered);
- broad-billed hummingbird (*Cynanthus latirostris*-State Endangered);
- willow flycatcher (*Empidonax trailii*-State Endangered);
- spotted bat (*Euderma maculatum*-State Endangered);
- Wright's fishhook cactus (*Mammillaria wrightii*-State Endangered);
- Santa Fe cholla (*Opuntia viridiflora*-State Endangered); and
- grama grass cactus (*Pediocactus papyracanthus*-State Endangered and Federal Candidate).

As a result of a habitat evaluation and previous data from the operable unit, none of the above species appear to have potential occurrence in the project area.

Currently, there are no wetlands located within the operable unit. However, wetlands are likely to develop in Canada del Buey, when the Sanitary Waste Water System Consolidation project goes on line. Potential floodplains were found within the canyon systems, and, although present, these floodplains will not be adversely affected by the proposed action and therefore no mitigation measures are necessary.

3.6.3.1 Recommendation

Impacts on non-sensitive plant species should be avoided when possible. Off-road driving is especially harmful to plants and soil crust. Vehicular travel should be restricted to existing roads whenever possible. If off-road travel is required, EM-8 should be contacted to monitor the activity. Revegetation may be required at some

sites. A list of native plants suitable for revegetation for OU 1148 is contained in the final report "Biological Assessment for Environmental Restoration Program, OU 1148".

3.7 Cultural Resources

3.7.1 Summary

As required by the National Historic Preservation Act of 1966 (as amended), a cultural resource survey was conducted during the summer of 1991 at Operable Unit (OU) 1148. The methods and techniques used for this survey conform to those specified in the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation (Federal Register Vol. 48 No 190, Thursday, September 29, 1983).

A total of sixty-nine archaeological sites have been located with the boundary of OU 1148. Of this number, fifty-six sites are eligible for inclusion on the National Register of Historic Places and twelve have been declared ineligible. The following sites are no longer eligible for Register inclusion under Criterion D of 36 CFR 60 because their research potential has been exhausted through complete excavation or recordation: Laboratory of Anthropology (LA) 4618, LA 4627, LA 4628, LA 4629, LA 4630, LA 4631, LA 4632, LA 4633, LA 71160, LA 82607. The following sites are no longer eligible for register inclusion because they have lost site integrity: LA 12706-A and LA 12706-B. The following sites are eligible under Criterion D (36 CFR 60) for their research potential: LA 4612-A, LA 4612-B, LA 4612-C, LA 4613 through LA 4617, LA 4619 through LA 4622-A, LA 4622-B, LA 4623 through LA 4626, LA 12587-A, LA 12587-B, LA 12587-C, LA 12587-D, LA 12714, LA 12600, LA 12599, LA 12598, LA 20969, LA 82605, LA 86615 through LA 86640. The remaining site, LA 170, Tshirege, is ancestral to the Pueblo of San Ildefonso. Not only is Tshirege eligible for National Register inclusion under Criteria A, B, C, and D, it is an important traditional and cultural location for the people of San Ildefonso, and as such, is protected by the American Indian Religious Freedom Act (AIRFA), the Native American Graves Protection and Repatriation Act (NAGPRA), and Bulletin 38 of the Federal Register (Interagency Resources Division, National Park Service).

The attributes of those sites eligible under Criterion D will not be affected by any ER sampling activities proposed at OU 1148. No sampling may take place within the boundaries of Tshirege without the consent of the tribal government of San Ildefonso Pueblo. Any sampling conducted adjacent to the boundaries of Tshirege in Canada del Buey or Pajarito Canyon must be monitored by an archaeologist.

A report documenting the survey area, methods, results, and monitoring recommendations will be transmitted to the New Mexico State Historic Preservation Officer (SHPO) for his concurrence in a "Determination of No Effect". 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 for comment on any possible impacts to sacred and traditional places. All monitoring

and avoidance recommendations contained in the report must be followed by all personnel involved in ER sampling activities.

3.8 Demography

3.8.1 Introduction

TAs 51 and 54 are located on Mesita del Buey. Access to Canada del Buey, on the eastern boundary of the study area, is restricted to the public by a security fence. The land to the east of the canyon is held by the San Ildefonso Pueblo, and public access is limited by a barbed wire fence and posted "No Trespassing" signs. Pajarito Road, along the western boundary of the study area, is used as a public access route from White Rock through the Laboratory to the Los Alamos townsite, with a traffic volume of approximately 8,000 automobiles per day (Environmental Protection Group 1990, 0497).

Land use in the vicinity of the Laboratory (including TA-54) is described in Section 2.5.1, of the 1991 IWP. For TA-54, land use in the immediate vicinity is unlikely to change while the Laboratory is operated by the DOE. Outside of the immediate vicinity of TA-54, land use patterns can be expected to remain within the constraints imposed by Laboratory and private land ownership: little large-scale agriculture is anticipated, home gardens are typical, and residences will be primarily in developed areas. The RCRA Operating Permit documents partial closure of TA-54 in the year 2100. Post-closure care will continue as this area will be under institutional control.

3.8.2 Site-Specific Demography

Access to TA-51 and the upper half of TA-54 is not restricted and employees often walk or jog in the area during the lunch hour. There is no evidence that non-employees use the area for recreational purposes.

As of June 1991, the TA-51 worker population, both Laboratory employees and contractors, totalled 26 people from ESS-1. In September 1991, five employees from EM-9 began work at TA-51. About one third of the employees work predominantly out-of-doors. The number of employees at TA-51 is expected to grow over the next five years.

As of June 1991, the TA-54 worker population totalled 84 people: 30 from EM-7's Chemical Waste Operations Section, 40 from EM-7's RadWaste Section, and 14 from EM-7's Gas Cylinder Project (the Gas Cylinder Project is expected to conclude in September 1991). Approximately one half of the employees at TA-54 work outside most of the time. The number of TA-54 employees is expected to continue to grow over the next five years.

3.8.3 Residential Demography

The Environmental Protection Group (EM-8) estimates that 213,000 persons lived within a 50 mi radius of Los Alamos in July 1990. Los Alamos County had an estimated population of 18,115 based on the 1990 U.S. Census.

The 1991 IWP (Section 2.5.4) describes the population within an 80 km radius of TA-54. The county has two residential and commercial areas (Los Alamos and White Rock). The Los Alamos townsite, the original site of the Laboratory and its support area, includes the Eastern Area, the Western Area, North Community, Barranca Mesa, and North Mesa. The townsite had a 1990 population of 11,347.

The White Rock area is the nearest residential area to TA-51 and TA-54. It includes the residential areas of La Senda and Pajarito Acres, and had an estimated 1990 population of 6,768 people. White Rock lies east-southeast of TA-51 and TA-54; it borders the south side of State Road 4 for approximately two mi. After Pajarito Road intersects State Road 4, it turns into Grand Canyon Drive and passes through a residential neighborhood at the areal center of White Rock. Distances from the Pajarito Road (Grand Canyon Drive)/State Road 4 intersection to TA-51 (Leonard Road entrance), TA-54, MDA L, and TA-54, MDA G are 3.2 mi, 2.0 mi, and 1.0 mi, respectively (Environmental Protection Group 1990, 0497).

3.9. Framework Studies

Framework studies at OU 1148 are proposed to provide additional information on the geologic setting at OU 1148.

3.9.1 Characterization of Stratigraphy of Tshirege Member of Bandelier Tuff

Specific stratigraphic layers within the Tshirege Member of the Bandelier Tuff may provide preferential migration pathways for contaminants at TA-54, such as the volcanic surge beds at the base of Unit 2b and pumice swarms elsewhere in the tuff (Sections 2.1.2.2 and 2.1.2.4.) These layers are intersected by disposal shafts at MDA H, MDA L and MDA G. Precise definition of these stratigraphic variations, including their characteristics and stratigraphic position, is required to direct the sampling of potentially critical migration pathways in the boreholes and predict the direction of transport. This data need can be filled by detailed mapping of the stratigraphy of the Tshirege Member at Mesita del Buey along canyon walls, supplemented by data from pits and drill holes.

Natural exposures of the Bandelier Tuff in the vicinity of Mesita del Buey occur along the south-facing canyon walls, where soil cover is absent. The stratigraphic variations in physical properties that may potentially enhance or impede subsurface transport will be described in a series of detailed measured stratigraphic sections along the north wall of Pajarito Canyon and the north wall of Canada del Buey. At least four sections will be measured and described in each canyon to document

spatial variations in the thickness of the units, including sections near MDA H, west of MDA L, near MDA L, near MDA G, and east of MDA G. The specific locations for the stratigraphic sections will be chosen to include the best-exposed sections of tuff. Descriptions will include lithologic variations in the tuff, stratigraphic contacts, welding and devitrification features, zones of vapor-phase crystallization, and variations in fracturing.

Critical contacts will be identified from the measured stratigraphic sections, and these contacts will be mapped in Pajarito Canyon and Canada del Buey. Locations of the critical contacts, such as the volcanic surge beds at the base of Unit 2b, will be surveyed in reference to established bench marks to aid in preparing a structure contour map showing the elevation of these contacts beneath Mesita del Buey. This structure contour map will also utilize contacts identified from pits and drill holes at TA-54.

3.9.2 Characterization of Fracture Coatings

Although significant movement of moisture to depths greater than 10-15 ft was not apparent in neutron-probe measurements in two drill holes at TA-54, observations of fractures in open pits demonstrate that water has penetrated to at least the bottom of the blowholes discussed in Section 3.4.3 (Section 2.1.3.3). The critical assumption that liquid-phase transport along fractures is not a viable pathway for contaminant migration at TA-54 can be supported with systematic data on the characteristics of fracture coatings. Specifically, the frequency and thickness of fracture coatings may decrease dramatically with depth in the tuff, providing evidence that water infiltrating downward along fractures beneath the mesa tops is being absorbed into the tuff and is not reaching the base of the Bandelier Tuff. Additional data on the nature and distribution of fracture coatings, including caliche and clays, will allow an improved characterization of long-term moisture movement along fractures. These data will be obtained by an examination of cores to be acquired as part of other tasks at TA-54, and will not require the drilling of additional holes.

In each core, the location of each fracture and the nature and thickness of any fracture coatings will be recorded. A subset of the recorded fracture coatings will be selected to characterize fracture-lining materials, including the following:

- clay mineralogy,
- carbonate mineralogy,
- iron and manganese mineralogy,
- zeolite mineralogy, and
- total organic carbon.

Laboratory tests will be performed using either an appropriate Laboratory ER Program SOPs or conventional laboratory methods. These procedures include but not limited to

- pulverizing rock samples for chemical and mineralogic analyses,
- collecting mineralogic data by x-ray diffraction,
- purification of zeolite samples for mineralogic identification, and
- laboratory method to determine total organic carbon.

3.9.3 Deep Drill Hole

3.9.3.1 Introduction

Knowledge of transport pathways in the vadose zone and subsurface characteristics beneath OU 1148 is incomplete. This data need can be filled with a strategically placed deep drill hole east of MDA G. Regional geologic information indicates that the total thickness of the Bandelier Tuff decreases in the eastern region of Mesita del Buey. The thickness of the Bandelier Tuff below MDA G is not accurately known. Characteristics of the geologic units below the Bandelier Tuff with regard to migration of contaminants are not well understood. The geologic units that require characterization are the Cerros Del Rio Basalts and the thick clay-rich sediments that are present in the weathering profile above the basalt.

Perched aquifers, recharged from the alluvial aquifer in Pajarito Canyon, may exist in the subsurface in the southern vicinity of OU 1148, although no drill holes are available to determine if they exist. Emplacement of a deep drill hole to the main aquifer down-gradient of OU 1148 would provide the necessary data to determine if perched aquifers exist and their stratigraphic position. The perched aquifer may occur above thick clay-rich deposits in the weathering profile above the Cerros Del Rio Basalts.

3.9.3.2 Drilling Program for Subsurface Characterization

One deep drill hole to the top of the main aquifer is planned at the east end of Mesita del Buey (Figure 3.9-1). The drill site was selected as the stratigraphy at the eastern end of TA-54 is unknown. The site is distant enough from MDA G that no contaminants will be present in the vadose zone, although pore gas samples will be collected to test for vapor-phase transport. The site is located midway between Pajarito Canyon and Canada del Buey to minimize the possibility of opening potential transport pathways from alluvial aquifers to deeper aquifers. The deep stratigraphic test hole will be drilled on a time line towards the end of the Phase I field work at MDA G in order to use the data collected at the MDA to direct the drilling and sampling program for the deep drill hole. The depth of the deep drill hole will be based on the depth of contamination found at MDA G. If COCs are found in the basalt at MDA G then the deep drill hole will be advanced 50 ft into the main aquifer. If COCs are not detected below the tuff then the drill hole will terminate in the basalt above the main aquifer to characterize lithologic and transport properties of the basalt. The estimated subsurface characteristics at the site are presented in Table 3.9-1.

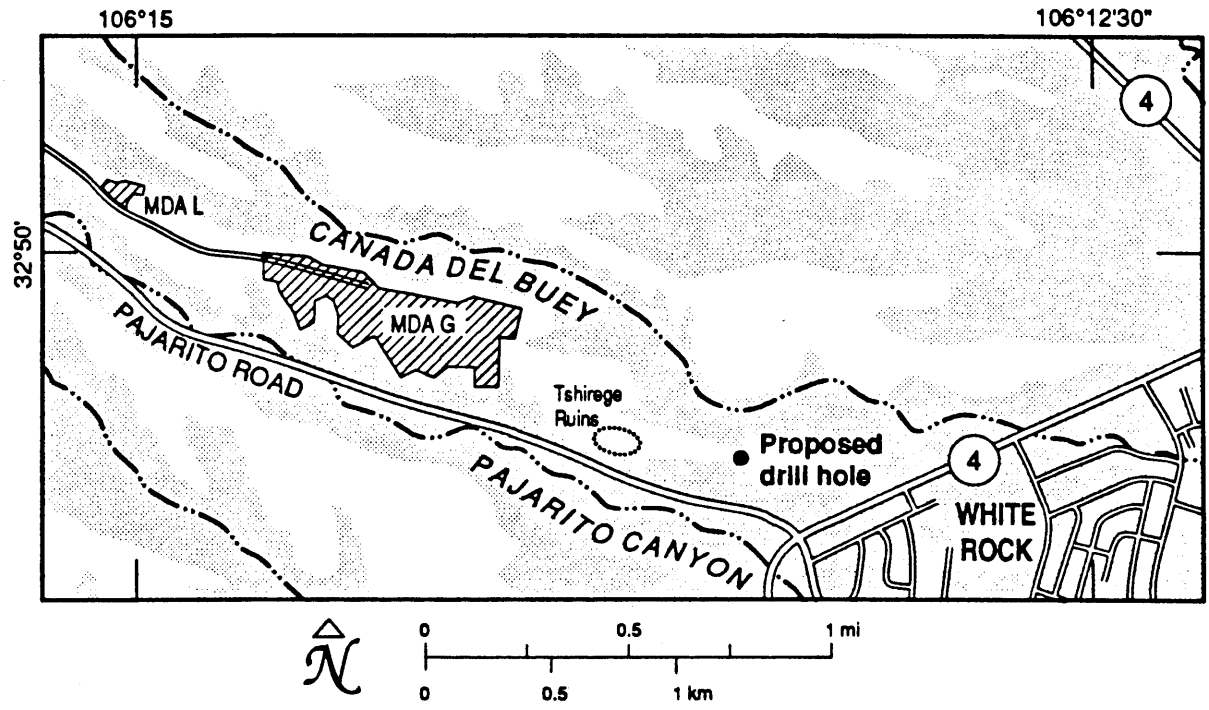


Figure 3.9-1 Location map for proposed deep drill hole.

The hole will be continuously cored using air-rotary drilling. The core will then be labeled and curated, following Laboratory ER Program SOPs, to allow detailed geologic and hydrologic characterization at a later date if desired. Requirements for the drilling include the following:

- continuous core sampling;
- an open drill hole for a suite of borehole geophysical logs and for *in situ* tests to collect gas samples. The walls of the drill hole must be free of contamination by drilling fluids or by air used for drilling; and
- the diameter of the finished drill hole must be suitable for installation of monitor well casing. A 10 in. diameter is preferred for the drill hole.

Drilling will stop if a perched aquifer is intersected, and the hole will be cased and completed as a monitor well. If the deep drill hole is to be advanced to the main aquifer, a second hole will then be drilled nearby, and completed to the main aquifer. This second hole, if necessary, will be continuously cased with ODEX casing to prevent communication between perched aquifers and the main aquifer. Because the top of the main aquifer is believed to be below 5750 ft (Purtymun and Johansen 1974, 0199), if water is encountered above 5800 ft elevation, it will be assumed to be perched above the main aquifer. When water is reached below 5800 ft, drilling will continue for 50 ft to confirm that the main aquifer has been reached and to determine the geologic characteristics of the uppermost aquifer. The hole will be cased and completed to allow sampling and monitoring of the top of the aquifer.

3.9.3.3 Geophysical Logs in the Borehole

A suite of geophysical logs will be collected in the borehole. The logs will be collected to extend information gathered from geologic description and tests performed on core samples. The logs will enhance stratigraphic correlation, identify and map orientation of fractures and joints, define the relative variation in moisture within the unsaturated zone, and define the variations in bulk density within the stratigraphic section. Table 3.9-2 lists the logs to be collected in the borehole and describes the objective of each log.

All borehole geophysical logging activities will be performed in accordance with either Laboratory ER Program SOPS, or conventional field procedures which cover the following areas of investigation:

- Borehole Gamma Logging,
- Borehole Neutron Logging,
- Borehole Caliper Logging,
- Borehole Video Logging (Axial and Sidescan),
- Borehole Induction (Geonics EM-39) Logging,
- Borehole Magnetic Susceptibility Logging (Romulus Instrument), and
- Borehole Temperature Gradient Logging.

TABLE 3.9-1
ESTIMATED SUBSURFACE CHARACTERISTICS AT DRILL HOLE LOCATION

Estimated Surface Elevation [a]	6550 ft
Estimated Elevation at Top of Main Aquifer [b]	5850 ft +/- 50 ft
Most Likely Horizons for Perched Aquifers	5900 ft-6500 ft
Estimated Thickness of Subsurface Units	
Bandelier Tuff	30 ft-100 ft
Basalt (with possible interbedded gravel)	600 ft-700 ft
Puye Formation conglomerates	>100 ft

[a] Drill hole location shown in Figure 3.9-1.
[b] Top of main aquifer estimated from Purtymun and Johansen (1974, 0199).

TABLE 3.9-2
SUITE OF GEOPHYSICAL LOGS

Hydrogeological	Characterization
Open Hole	
Thermal Neutron (Moisture)	% moisture, perched zones
Gamma (Density)	bulk density of rocks
Caliper	fracture
Axial Borehole Video	fracture orientation
Sidescan Borehole Video	fracture orientation
EM Induction (Geonics EM-39)	stratigraphic correlation, perched zones
Magnetic Susceptibility (Romulus)	stratigraphic correlation
Natural Gamma	stratigraphic correlation
Spectral Gamma (U, TH, K)	stratigraphic correlation
Cased Hole	
Thermal Neutron (Moisture)	% moisture, perched zones
Gamma (Density)	% moisture, perched zones
EM Induction (PVC Casing)	perched zones
Natural Gamma	stratigraphic correlation
Spectral Gamma (U, TH, K)	stratigraphic correlation
Temperature Gradient (Requires fluid-stemming casing)	vapor phase transport

3.9.3.4 Characterization of Groundwater

Groundwater from the top of the main aquifer and any perched aquifers that may be encountered (Section 3.9.3.2) will be sampled and analyzed for volatile, organic and inorganic constituents, and for stable and radioactive isotopes. The analytical suite is presented in Table 3.9-3. These analyses will confirm the absence of contamination of groundwater in the main aquifer. In addition, the analyses of radioactive isotopes will allow absolute ages of the groundwater to be determined and help define the recharge history of the aquifer. The samples will be collected using a method to prevent aeration and will be immediately sealed in an air tight glass bottle. Sample collection and laboratory tests will be performed using conventional laboratory methods which cover the following areas:

- field methodology to collect and preserve groundwater samples from seeps, springs, and monitoring wells for environmental analyses, and
- laboratory methods to analyze water samples for environmental isotopes.

3.9.3.5 Pore Gas Collection from Open Borehole

Pore gas samples will be collected from the borehole during the in situ air permeability tests. Pore gas samples will be collected approximately every 50 ft, with the testing intervals selected based on results of the geologic description of the core and the interpretation of the suite of borehole geophysical logs. Zones of basaltic breccia between individual basalt flows will be preferentially sampled because they may have the highest intrinsic permeability and may be the most likely pathway for vapor transport.

The collected gas samples will be analyzed for the following:

- volatile organic constituents,
- relative humidity, and
- SF_6 (a gas introduced during drilling to trace contamination of *in situ* pore gas by drilling air).

Sample collection and laboratory tests will be performed using either appropriate Laboratory ER Program SOPs, or conventional field and laboratory procedures which cover the following areas:

- field methodology to collect and preserve pore gas samples collected from discrete intervals in open boreholes, and
- laboratory method to analyze constituents in pore gas samples.

TABLE 3.9-3
ANALYTICAL SUITE FOR GROUNDWATER SAMPLES COLLECTED FROM PERCHED ZONES, AND THE MAIN AQUIFER

Major Anions
Carbonate
Chloride
Sulfate
Fluoride
Nitrate
Nitrate and Nitrite
Phosphate

Major Cations
Ammonium
Calcium
Magnesium
Potassium
Sodium
Silica

Radionuclides
Gross alpha
Gross beta
Radium-226
Thorium-230

Other Parameters
Total Organic Carbon
Total suspended solids (<10 micron)

Field Measured Parameters
Temperature
Ph
Eh
Specific Conductance
Alkalinity
Dissolved Oxygen

Minor and Trace Constituents
Aluminum
Arsenic
Barium
Beryllium
Boron
Bromide
Cadmium
Chromium
Cobalt
Copper
Cyanide
Iron
Lead
Manganese
Mercury
Molybdenum
Nickel
Selenium
Silver
Sulfide (as H_2S)
Strontium
Thallium
Uranium
Vanadium
Zinc

Environmental Isotopes
Strontium-86/Strontium-87
Hydrogen/Deuterium
Oxygen-16/Oxygen-18
Tritium
Carbon-14

Samples of core will be selected every 5 ft from the lowermost 20 ft of the Bandelier Tuff, and from the immediately underlying weathered basalt. Intact, high quality core samples will be submitted to a geotechnical laboratory for the following suite of analyses:

- gravimetric moisture content,
- porosity (helium injection test),
- bulk density,
- saturated hydraulic conductivity, and
- air-water relative permeability.

The discrete core samples must be sealed in air tight containers at the time of collection in order to prevent changes in moisture content. Sample collection and laboratory tests will be performed using either appropriate Laboratory ER Program SOPs or conventional laboratory methods. These include but are not limited to the following:

- field methodology to collect and preserve rock core samples for hydrogeologic parameter tests;
- laboratory method to determine gravimetric moisture content on rock samples (ASTM method D-4531-86);
- laboratory method (helium injection test) to determine porosity on intact, undisturbed rock core samples (American Petroleum Institute Method 40, Section 3.58);
- laboratory method to determine bulk density on intact, undisturbed rock core (ASTM Method D-4531-86);
- laboratory method to determine saturated hydraulic conductivity on intact, undisturbed rock core samples (ASTM Method D-2434-68); and
- laboratory method to determine air-water relative permeability on intact, undisturbed rock core samples.

An inflatable straddle packer assembly will be used to determine *in situ* permeabilities for the same intervals that are sampled for laboratory analyses to provide a confirmation of the laboratory results. The testing method will be vacuum extraction.

The suite of samples to be taken for Mesita del Buey drill holes is given in Table 3.9-4.

3.10 Three-Dimensional Geologic/Hydrologic Model

Figure 3.10-1 presents the three-dimensional geologic/hydrogeologic model for OU 1148 which reflects the conceptual model described in Section 1.4. The airborne pathway is presented and represents the movement of gases from the subsurface to the atmosphere and the movement of dusts and vapor. Surface water runoff

Table 3.9-4

Initial Geophysical Investigations
For Mesa Top Characterization Borehole

Suite of Samples for Mesita Del Buey Drill Holes

Sample Type	Sampling Location	Interval	Sample Identification	Hydrological and Geotechnical: Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (He injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry pH	Environmental Isotopes: Chloride-35/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-18/Oxygen-18	Tritium	Carbon-14	Chloride-36	In Situ Permeability	VOCs - Pore Gas	CO2 - Pore Gas	Relative Humidity - Pore Gas	SF6	Open Hole Tests Geophysics: Thermal Neutron (moisture)	Gamma gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Side Scan Video
Continuous Logging of Drill Hole																																								
		20-15		X	X	X	X	X	X	X	X	X		X				X	X								X					X	X	X	X	X	X	X	X
		15-10		X	X	X	X	X	X	X	X	X		X				X	X								X					X	X	X	X	X	X	X	X
		10-5		X	X	X	X	X	X	X	X	X		X				X	X								X					X	X	X	X	X	X	X	X
		5-0		X	X	X	X	X	X	X	X	X		X				X	X								X					X	X	X	X	X	X	X	X
Reference to Base of		0-0		X																																			
Bandelier Tuff		0-5		X	X	X	X	X	X	X	X	X		X				X	X								X					X	X	X	X	X	X	X	X
		20-25																										X	X	X	X								
		70-75																										X	X	X	X								
		120-125																										X	X	X	X								
		170-175																										X	X	X	X								
		220-225																										X	X	X	X								
		270-275																										X	X	X	X								

X Indicates an interval where a planned screening or analysis sample will be collected

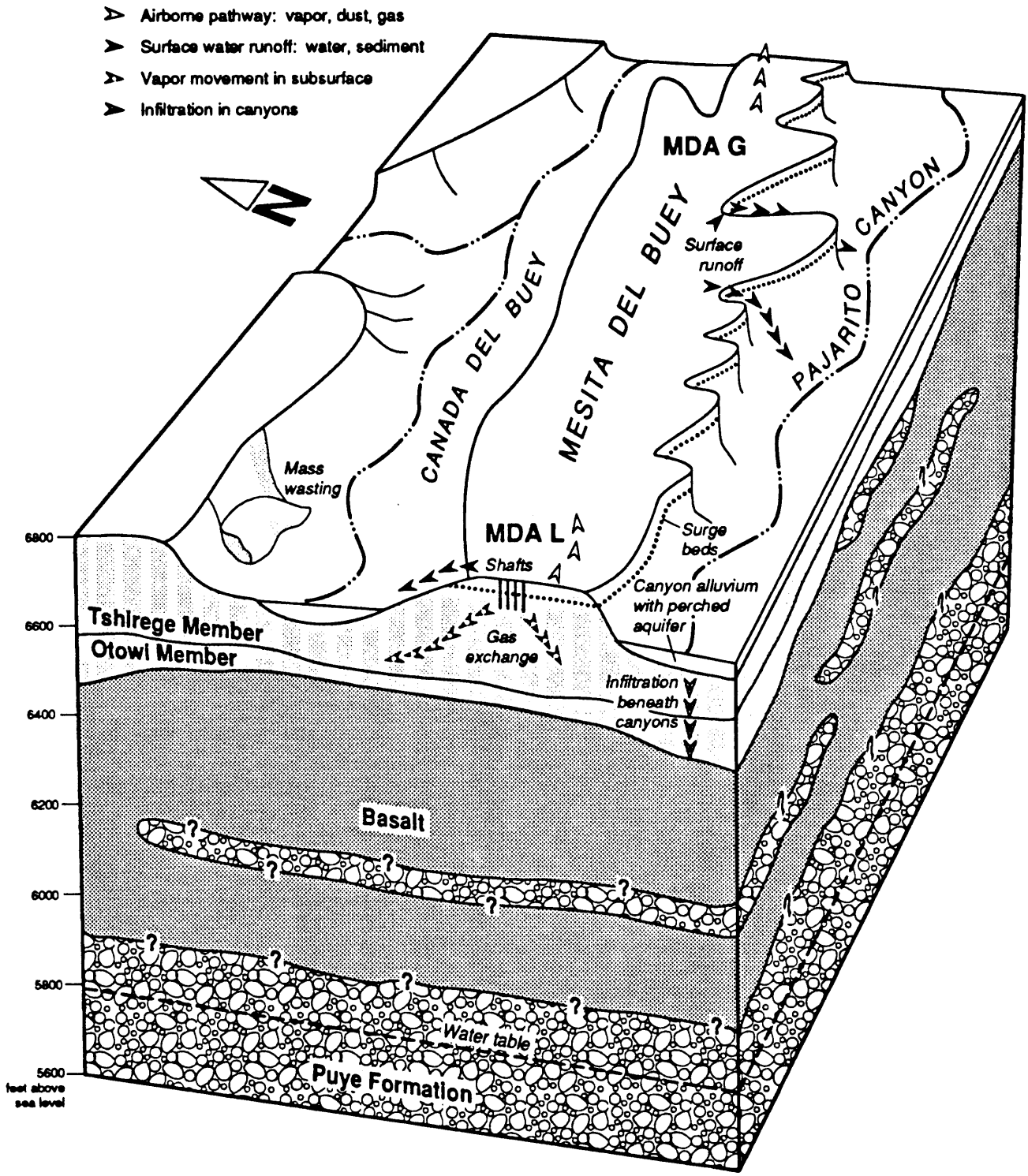
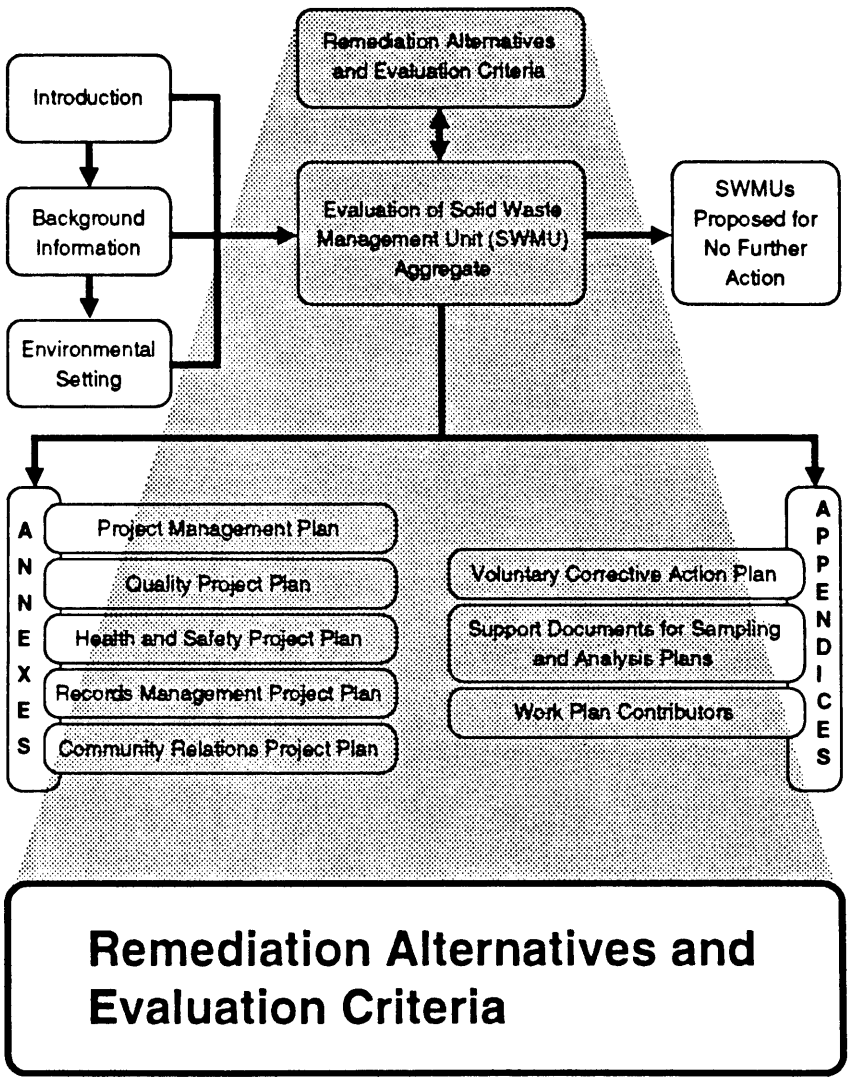


Figure 3.10-1 Three-dimensional geologic/hydrologic model of OU 1148.

includes the movement of runoff as well as the movement of sediment in the runoff. Subsurface movement of contaminants is principally the movement of VOC vapors (IT Corporation 1987, 0327).

CHAPTER 4


Remediation Alternatives and Evaluation Criteria
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Background Information
Environmental Setting
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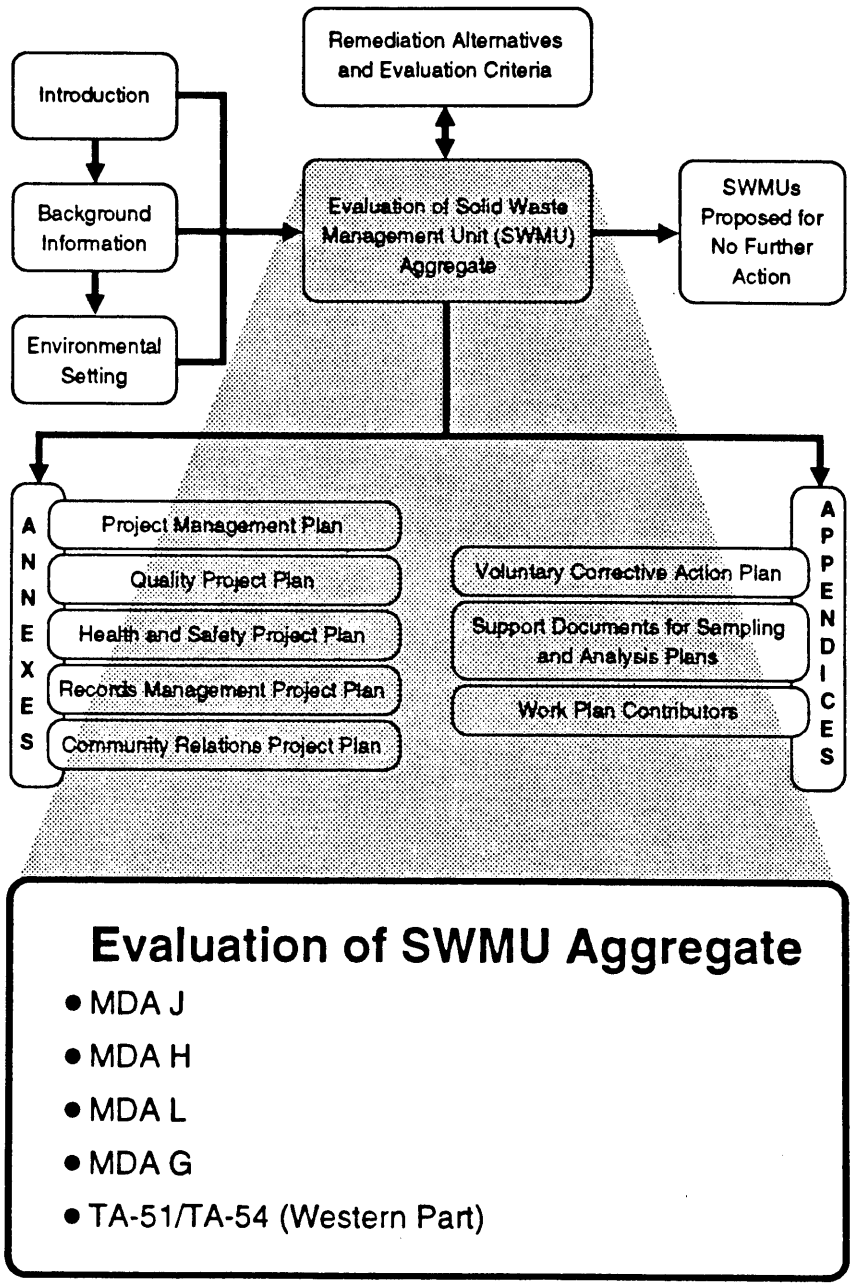
Remediation Alternatives and Evaluation Criteria

4.0 REMEDIATION ALTERNATIVES AND EVALUATION CRITERIA

The decision analysis approach, which provides for efficient identification and evaluation of corrective measures alternatives is described in Appendix I of the IWP (LANL 1991, 0553). This appendix describes how decision analysis will be used in the ER Program. Because the decision analysis process is being developed concurrently with this work plan, the process will be applied to this operable unit during the first year of field work, reflecting the decision-making framework described in the IWP. Future documents describing work at the operable unit will also reflect this approach.

CHAPTER 5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5.0 EVALUATION OF SOLID WASTE MANAGEMENT UNIT AGGREGATES

5.1 Material Disposal Area J

Material Disposal Area (MDA) J contains one Solid Waste Management Unit (SWMU) Aggregate which will be investigated under the Environmental Restoration (ER) Program which consists of subsurface (disposal) units. The location of MDA J in Technical Area 54 (TA-54) is shown on Figure 1.0-3.

5.1.1 Background

5.1.1.1 Description and History of SWMU

MDA J is a 2.65-acre site that is currently used for the disposal of administratively-controlled waste. The area was designated for waste disposal in 1961 when Pit 1 was excavated (Figure 5.1-1). Administratively-controlled waste is defined by the Laboratory as "those wastes which are generated by various operating and experimental groups and, although nonhazardous, are restricted by the Laboratory from disposal in the Los Alamos County landfill or other locations" (Krueger 1991, 0036). Examples of administratively-controlled wastes are classified items such as safes with secured locks, objects with classified shapes, scrap equipment, treated sand from barium sand treatment operations at MDA L, and empty containers. In general, these wastes are neither hazardous nor radioactive, but for security and/or safety reasons, the Laboratory desires to maintain long-term institutional control over them.

Historically, MDA J received wastes that were potentially contaminated with trace quantities of nonreactive high-explosive residues. Other wastes buried in early operations include discarded equipment, asbestos, and minimal amounts (mostly residual) of hazardous waste.

Subsurface Disposal Units

Subsurface disposal units at MDA J consist of four pits and two shafts. They are collectively identified as SWMU 54-005 in the Solid Waste Management Units Report (LANL 1990, 0145). The locations of pits and shafts in MDA J are shown on Figure 5.1-1.

Figure 5.1-1 shows the locations of two pits (5 and 6) that have been excavated, but have not yet received waste. Waste-disposal logs have been maintained for all subsurface disposal units and serve as the basis for the source term description in Section 5.1.1.2.1. MDA J records indicate only a minor potential for hazardous waste or hazardous constituent releases from these units because of the controls exercised over the types of wastes that could be disposed of in them.

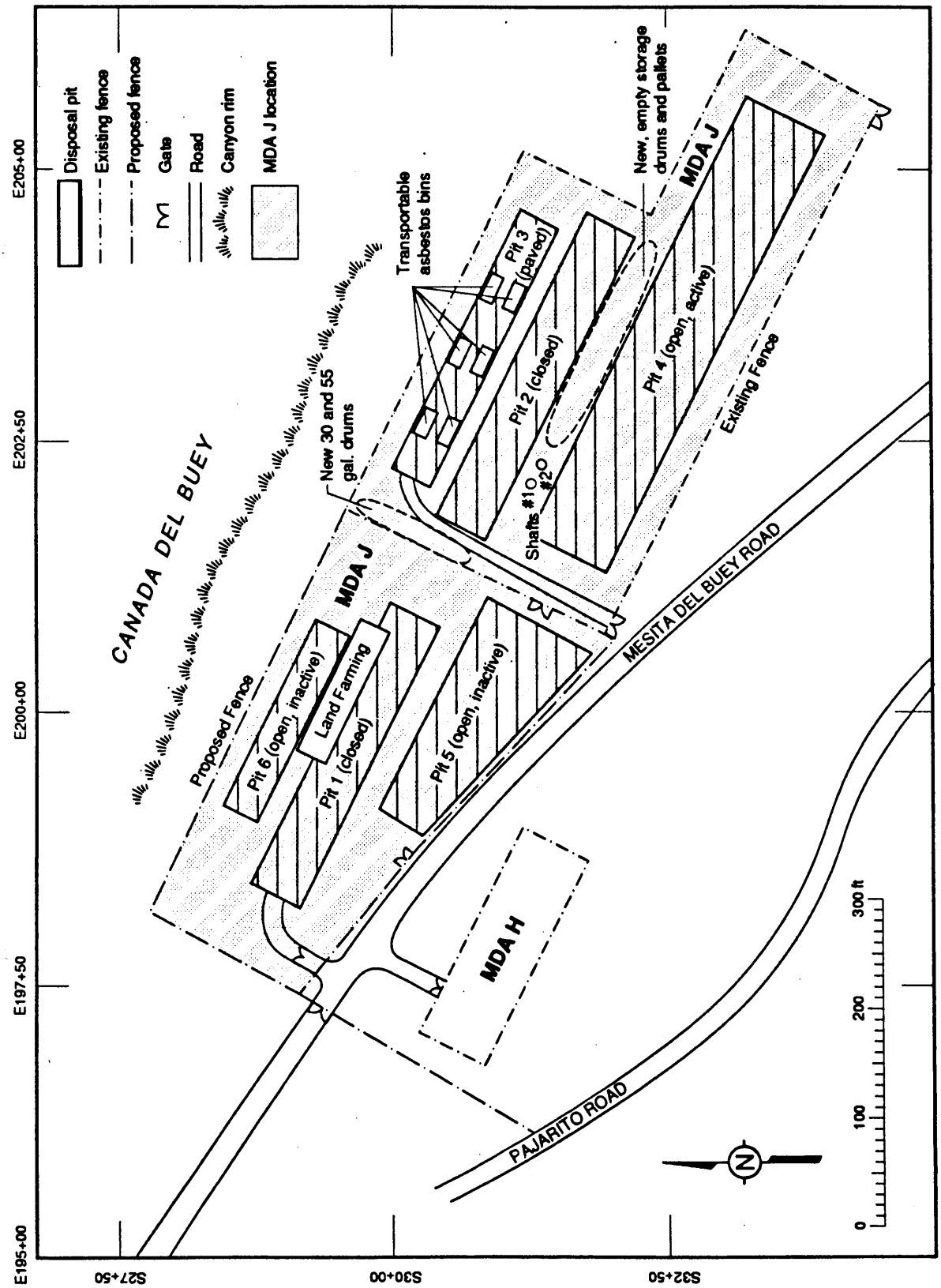

Figure 5.1-1 Location of pits and shafts in MDA J at TA-54.

Pits 1, 5, and 6 are located outside the intrusion fence; Pits 2, 3, and 4, and Shafts 1 and 2 are located inside the intrusion fence.

Pit 1 was excavated in 1961 and was used for waste disposal until 1966. It measures approximately 250 ft long, 51 ft wide, and 17 ft deep. Waste disposal procedures associated with this pit required that wastes be placed in layers and covered with crushed tuff approximately 12 in thick. To minimize void space, hollow items or open, empty containers and vessels were emplaced so that they would be filled with subsequent layers of waste or tuff. Liquids were prohibited from disposal. The pit is unlined and no special provisions were made for run-on control. The pit was filled and covered with soil to grade in July 1967 (Benchmark 1991, 08-0023).

Pit 2 was excavated in 1967 to allow for continued disposal after Pit 1 had reached its maximum capacity. The dimensions of Pit 2 are approximately 200 ft long, 31 ft wide, and 17 ft deep. This pit is unlined and has no provisions for run-on control. Pit 2 was closed after April 1982 (Benchmark 1991, 08-0023).

Pit 3 was excavated in or about 1984 (Benchmark 1991, 08-0023). The approximate dimensions of Pit 3 are 169 ft long, 25 ft wide, and 45 ft deep.

Pit 4 is currently in operation at MDA J. Constructed in or about 1987 (Benchmark 1991, 08-0023), the pit measures 425 ft long, 80 ft wide, and 60 ft deep and is used solely for the purpose of disposing of administratively-controlled waste.

Shaft 1 was drilled in or about 1984 and was first used in January 1985. It is 6 ft in diameter and 65 ft deep (IT Corporation 08-0028). The shaft is inactive and will be sealed in the near future.

Shaft 2 was drilled in or about 1984. It is 6 ft in diameter and 65 ft deep (IT Corporation 1991, 08-0028). The shaft is in active use for disposal of classified waste.

Surface Storage Units

Surface storage waste management units at MDA J include seven roll-off dumpsters used for temporary storage of friable and nonfriable asbestos removed from facilities throughout the Laboratory. Friable asbestos is placed in plastic bags, and then in dumpsters, before transport to MDA J. Nonfriable asbestos safes and ovens do not require plastic packaging. Both forms of asbestos are shipped off site for disposal.

Land Farming Project

Since January 1991, MDA J has served as the location for land farming (remediation) of contaminated soil from underground storage tank releases. The soil is taken to MDA J where it is spread in thin layers (approximately 6 inch lifts). The thin-spreading technique allows for enhanced aeration that facilitates volatilization of the light-end hydrocarbons and biodegradation of the remaining contaminants. The project is located outside the intrusion fence in a rectangular area flanking the north side of Pit 1. The land farm covers an area of 8,225 ft^2.

Land farming operations were suspended in June 1991 for a short time because of safety concerns during the construction of Pits 5 and 6. One of the new pits is immediately north of the land farm; the other pit is just south of Pit 1. Both of the new pits are located outside the intrusion fence, and have not yet received waste.

Soil deposited at the land farm prior to the suspension of operations remains at the site undergoing remediation (Benchmark 1991, 08-0023), and Laboratory staff members have reported that limited quantities of petroleum-contaminated soil have been thin-spread at the MDA J land farm site since June 1991 (Benchmark 1991, 08-0028). No long-term releases are identified. Petroleum wastes from underground storage tank releases are regulated by the New Mexico Environmental Improvement Board Underground Storage Tank Regulations (NMEIB-USTR), and are, therefore, exempt from Resource Conservation and Recovery Act (RCRA) regulation. No permit is required by the NMEIB-USTR. The procedures to treat soil at MDA J specify that the soil is to be thin-spread north of Pit 1.

5.1.1.2 Conceptual Exposure Model

5.1.1.2.1 Existing Information on Nature and Extent of Contamination

Waste disposed of at MDA J was characterized by reviewing specific historical documentation such as Laboratory records and logbooks, and by supplementing the specific documentation with interviews from current and past Laboratory staff members who have knowledge of MDA J disposal practices and activities. Specific information was collected, and a data base created as part of the effort to characterize the waste present in the disposal units at MDA J (see Appendices 3-A, 3-B, and 3-C of the Operable Unit 1148 Data Report [IT Corporation 1992, 08-0015]). Data contained in the MDA J source term data base have been categorized to facilitate current data analyses and are summarized in Tables 5.1-1 and 5.1-2.

The MDA J source term data base generated in this investigation is a comprehensive review of Laboratory records for waste disposed of at MDA J. However, it is important to note that only 942 of the 1,522 records were complete: 360 records did not specify a disposal location, and no logbook or Laboratory data base records were found for the calendar years 1965 or 1983.

To produce the most conservative scenario for the MDA J source term, wastes disposed of at MDA J were categorized into two main groups: nonhazardous constituent waste and hazardous constituent waste. If a waste contained even trace amounts of any compound listed in 40 U.S. Code of Federal Regulations (CFR) Part 261 Appendix VIII, the entire amount of that waste was considered hazardous constituent waste. For example, empty containers and drums that originally held a hazardous constituent were categorized as hazardous constituent wastes. With this approach, any potentially hazardous constituents would be subject to further scrutiny. Further examination of process knowledge was evaluated to determine actual hazardous characteristics and potential for contaminant plume source.

TABLE 5.1-1
SPECIFIED[a] AND UNSPECIFIED[b] VOLUMES (ft^3) AND WEIGHTS (lbs) OF MATERIALS DISPOSED OF AT TA-54, MDA J, PER YEAR[c]

Year	Specified Volume (ft^3) of Material Disposed	Unspecified Volume (ft^3) of Material Disposed	Specified Weight (lbs) of Material Disposed	Unspecified Weight (lbs) of Material Disposed
1964	NR[d]	NR	319,602	NR
1965	NR	NR	NR	NR
1966	NR	NR	2,768,745	NR
1967	NR	NR	1,595,650	NR
1968	NR	NR	133,330	NR
1969	NR	NR	78,450	NR
1970	NR	NR	165,305	NR
1971	NR	NR	66,550	NR
1972	NR	NR	9,560	NR
1973	NR	NR	40,285	NR
1974	NR	NR	21,800	NR
1975	NR	NR	16,300	NR
1976	NR	NR	20,950	NR
1977	NR	NR	30,425	NR
1978	NR	NR	6,500	NR
1979	NR	NR	25,300	NR
1980	NR	NR	11,300	NR
1981	NR	NR	93,000	NR
1982	NR	NR	3,500	NR
1983	NR	NR	NR	NR
1984	671	NR	6,400	NR
1985	2,442	NR	39,800	72,250
1986	6,203.8	NR	179,299	109,650
1987	7,500.12	766.74	275,333.9	89,540.76
1988	5,671.8	204	237.731	39,854
1989	34.61	40.16	10,110	17,508
1990	423.58	19.11	285,784	7,173
1991	233.83	92.93	77,787	14,392

[a] Specified values are sums from records that indicate disposal into a specific pit or shaft.
[b] Unspecified values are sums from records that did not indicate disposal into a specific pit or shaft.
[c] Most logbook entries and Laboratory data base entries reported disposal quantities in weight rather than volume amounts.
[d] NR Not recorded

TABLE 5.1-2
SPECIFIED[a] VOLUMES (ft^3) AND WEIGHTS (lbs) OF HAZARDOUS[b] AND NONHAZARDOUS CONSTITUENTS DISPOSED OF AT TA-54, AREA J, PER DISPOSAL UNIT

Pit or Shaft	Specified Volume (ft^3) of Hazardous Constituents Disposed	Specified Weight (lbs) of Hazardous Constituents Disposed	Specified Volume (ft^3) of Non-Hazardous Constituents Disposed	Specified Weight (lbs) of Non-Hazardous Constituents Disposed
Pit 1	NR[d]	845	NR	3,618,877.5
Pit 2	NR	80	265.02	2,265,952
Pit 3	367	28,573.4	21,158.45	695,881
Pit 4	7.58	7,695	651.17	352,074
Shaft 1	.02	.5	704.14	20,492
Shaft 2	NR	NR	13.24	3,296

[a] Specified volumes are sums from records that indicate disposal into a specific pit or shaft.
[b] Disposed materials that may contain even trace amounts of any of the compounds identified in 40 CFR §261, Appendix VIII.
[d] NR Not recorded

During the initial screening of MDA J waste records, more than 96% by weight of the wastes were nonhazardous. These wastes primarily included scrap metal and old metal equipment, construction debris, old furniture, and empty containers. Even with the conservative assumption that the entire amount of a waste was considered hazardous if it contained a residual amount of a hazardous constituent, only about 4% by weight of the wastes disposed of at MDA J were categorized as hazardous constituent wastes. Of these hazardous constituent wastes, greater than 93% by weight were barium sand residues, about 0.7% were items contaminated with inorganics, about 0.8% were empty containers, about 1% were items contaminated with organics, and about 3% were miscellaneous disposed materials assumed to be hazardous constituent wastes. Figure 5.1-2 illustrates the relationship between the various quantities of hazardous and nonhazardous constituent wastes.

Because barium sand residues comprise 93% of the MDA J wastes categorized as potentially hazardous, the activity generating the barium sand residues was scrutinized to identify through process knowledge whether the waste contained hazardous constituents. Sand is used as a buffer during the detonation of high explosive material at other locations at the Laboratory. After detonation, the residue is sent to MDA L, where it undergoes treatment that immobilizes the barium as barium sulfate. Following treatment, samples of the sand are analyzed to determine barium concentrations and other toxic metals remaining in the sand residue, according to the toxicity characteristic leaching procedure (TCLP). Only sand residues containing less than 100 ppm extractable barium have been disposed of at MDA J (Benchmark 1991, 08-0023).

The practice of performing sampling and analysis prior to disposal of the barium sand has been in effect since the first load of barium sand residue was taken to MDA J in or about 1985 (Benchmark 1991, 08-0023). The Laboratory's early practice was to determine whether the sand residues were hazardous waste based on a total metals analysis, rather than through TCLP. The Laboratory considered, for purposes of waste management, that sand residue containing 100 ppm total barium was a hazardous waste. Under RCRA regulations, barium concentrations of 100 ppm that are derived from TCLP, rather than a total metals analysis, are considered hazardous. Therefore, the Laboratory's practice of using a total metals analysis was conservative, resulting in classification of hazardous wastes that were well below the TCLP toxicity minimum concentrations.

Treatment to make the extractable barium insoluble and thus immobile was not initiated until approximately December 1988. Between 1985 and 1988, the untreated barium-contaminated sand residue that contained 100 ppm or greater total barium was stored at MDA L (Benchmark 1991, 08-0023). After the treatment process was implemented, all the accumulated and subsequently generated sand residues were treated and analyzed using TCLP to assure that extractable barium was well below the 100 ppm TCLP toxic concentration prior to disposal at MDA J. Additionally, the barium present in the treated sand residues disposed of at MDA J is in the form of an immobile sulfate; therefore, its potential for migration from the disposal units is unlikely (Benchmark 1991, 08-0023).

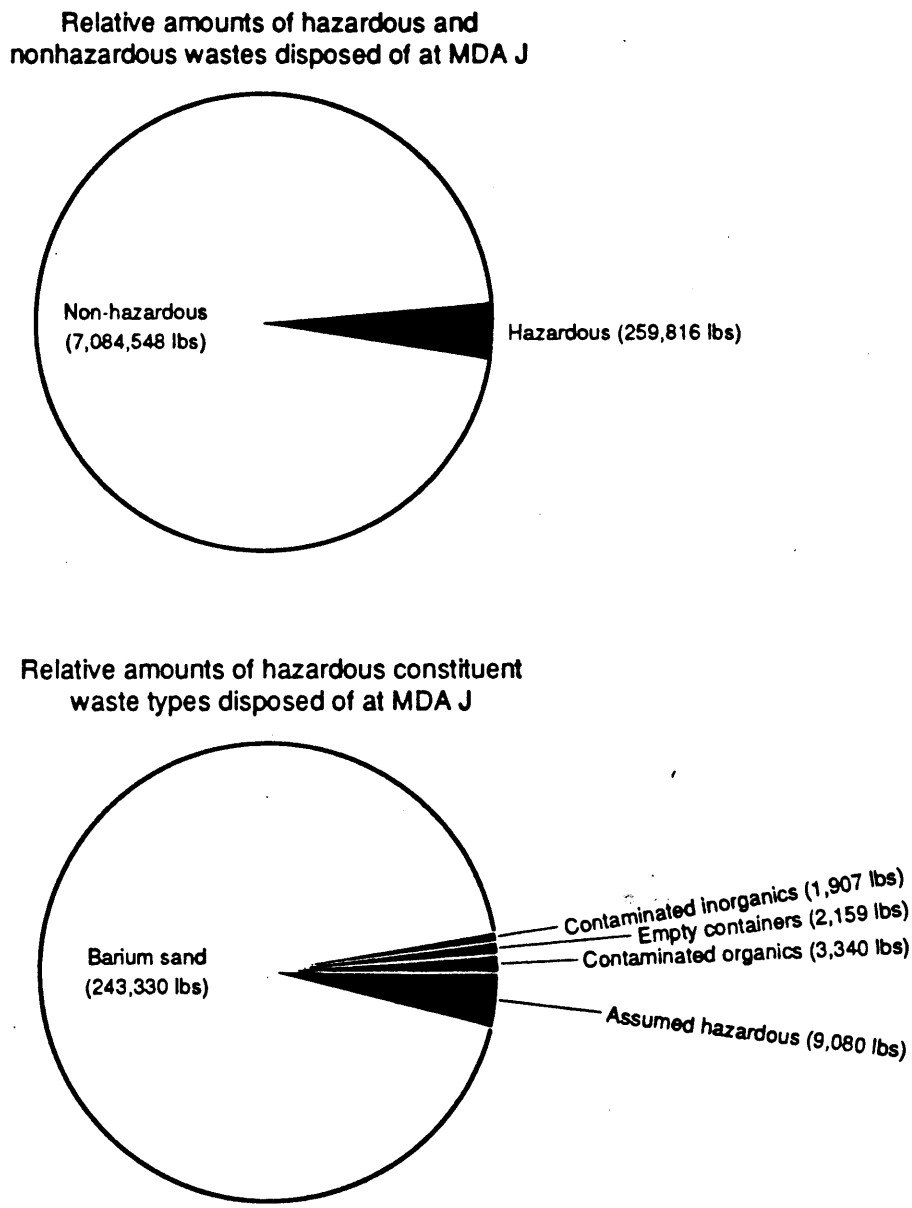

Figure 5.1-2 Relative amounts of waste types disposed of at MDA J.

The remainder of the disposed material initially categorized as hazardous constituent waste at MDA J consists of empty containers, items contaminated with inorganics, and items contaminated with organics. The empty containers include drums that originally held solvents or that may have held residual hazardous material. The items contaminated with inorganics include 100 lbs of flasks with high explosive-contaminated mercury, 0.5 lbs of beryllium, 600 lbs of a 30% beryllium alloy, 907 lbs of nickel metal parts, and 200 lbs of nonhazardous trash ash that was assumed to be hazardous constituent waste. The items contaminated with organics include 2,550 lbs of refrigerators contaminated with chloroform and phenol, 500 lbs of printer cartridges, a 250 lb labpack that was indicated as containing no RCRA items but was assumed to contain hazardous constituents, and 40 lbs of acetone and hexane mixed with rags and gloves. An additional 9,080 lbs of MDA J waste, described as miscellaneous, are assumed to be hazardous constituent wastes because no description of the wastes was provided in the disposal-record logbooks. Based on the inventory of wastes disposed of at MDA J, it is unlikely that these miscellaneously disposed materials were purely hazardous constituent wastes; however, the exact contents of these wastes are unknown and some hazardous constituents may have been present.

On the basis of the available data, there is evidence that small amounts of hazardous waste residues may have been disposed of at MDA J. The potential for migration of contaminants from MDA J is believed to be extremely low; however, because a potential exists, a limited sampling program is recommended at MDA J to test for any contamination.

5.1.1.2.2 Potential Pathways of Contaminant Migration

Due to the nature of the wastes disposed of at MDA J, no radioactive or hazardous wastes are expected to have been released from the disposal pits and shafts. One migration pathway of concern is the subsurface release of volatile contaminants. Volatile contaminants in the subsurface may migrate in vapor phase in the vadose zone and may be released to the atmosphere by evapotranspiration. MDA J is under institutional control, but surface contaminants may be transported beyond the area of institutional control by surface water runoff and sediment transport. Surface contaminants may be present due to spills, poor housekeeping, and volatile contaminant migration upward from a subsurface release. The conceptual model for MDA J is shown in Figure 5.1-3.

5.1.1.2.3 Potential Public Health and Environmental Impacts

Although contaminants are not expected to be found outside the disposal pits and shafts at MDA J, potential public health impacts outside the area of institutional control includes hikers exposed to surface water runoff and transported sediments in the drainages, and workers and joggers near MDA J exposed to volatile contaminants released to the air. The exposure risk is expected to be negligible due to dispersion in the migration pathways. Impacts to ground water are considered negligible due to dispersion of vapors migrating through approximately 1,000 ft of vadose zone to reach the main aquifer, and dispersion of contaminants transported

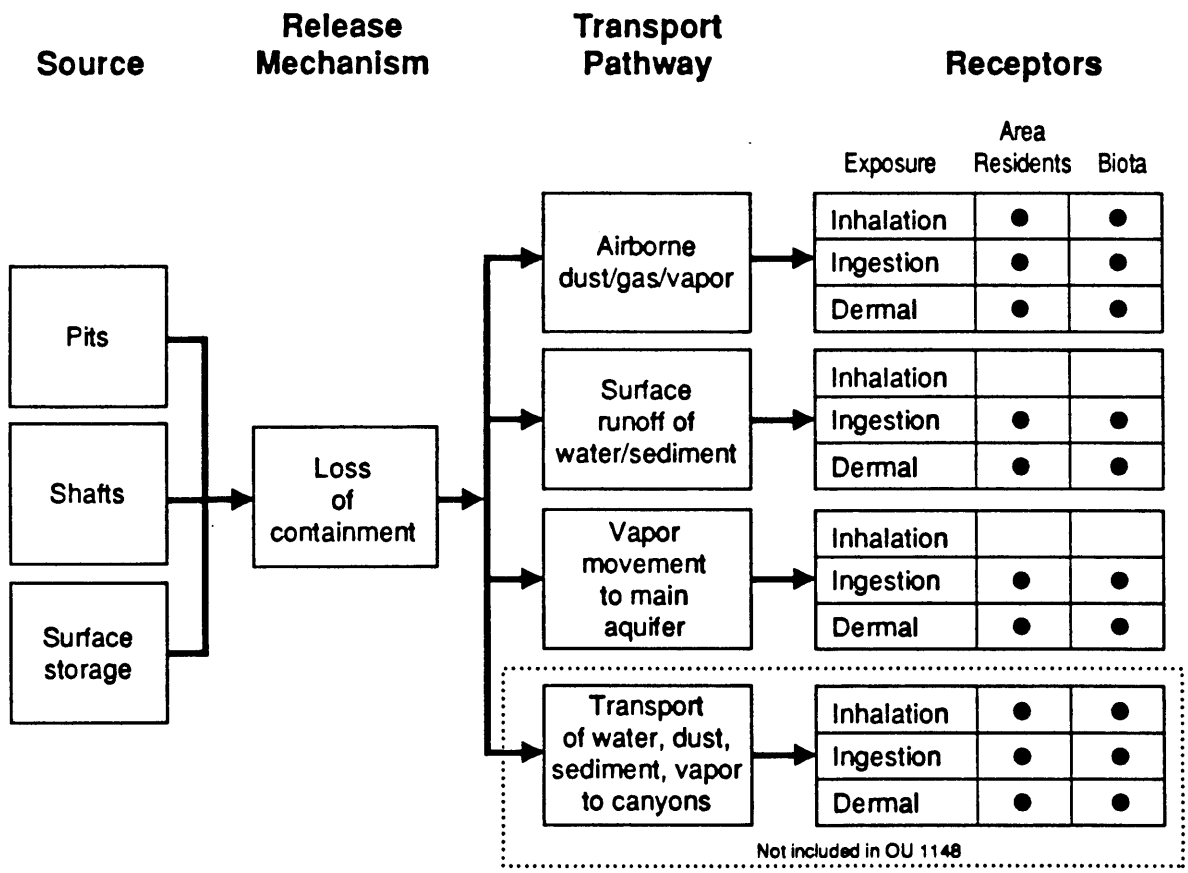

Figure 5.1-3 Conceptual model for MDA J.

by surface water to the alluvium in Cañada del Buey. In addition, perched aquifers are not believed to be present in Cañada del Buey.

5.1.2 Remediation Alternatives and Evaluation Criteria

MDA J has received classified wastes and will remain under institutional control indefinitely, and no releases of hazardous or radioactive contaminants are expected to be identified at MDA J. Therefore, MDA J is recommended for institutional control as a preliminary response action based on current information.

5.1.3 Data Needs and Data Quality Objectives

Based on records of disposal activities at MDA J, only residual amounts of hazardous wastes are expected to have been disposed of in the pits and shafts. There are no records of radioactive waste disposed of in MDA J. However, it is possible that small amounts of radioactive or hazardous wastes were disposed of in the pits and were not recorded. For this reason, a Phase I sampling program will be implemented to determine the presence or absence of contaminants outside the disposal pits and shafts in MDA J.

5.1.3.1 Health and Safety Risks

5.1.3.1.1 Source Characterization

The materials disposed of in the pits and shafts at MDA J are characterized from disposal records as discussed in Section 5.1.1.2.1. Phase I sampling will be performed to determine the presence or absence of contaminants outside the disposal pits and shafts at MDA J. If Phase I sampling indicates contaminants are moving beyond the point of institutional control, additional source characterization may be included as part of a Phase II sampling program.

The data presented in Table 5.1-3 will provide a better understanding of the information needed for source term characterization.

5.1.3.1.2 Environmental Setting

As discussed in Section 5.1.1.2.2, the migration pathways for contaminants released from MDA J have been modeled conceptually. Phase I investigations will include sampling to determine if contaminants are migrating via several pathways. These pathways are

- vapor phase migration in the subsurface;
- air migration of volatiles released to the atmosphere by evapotranspiration; and

TABLE 5.1-3
INFORMATION NEEDED FOR PHASE I SOURCE CHARACTERIZATION OF MDA J SUBSURFACE DISPOSAL UNITS*

1. Constituent Concentrations in Media

   SW-846 Volatile Organic Compounds (VOCs)
   SW-846 Semivolatile Organic Compounds (SVOCs)
   SW-846 Metals
   Pesticides
   PCBs
   Reactive Cyanide
   Tritium
   Gross alpha and beta radioactivity and gamma emitters

2. Media

   Surface Water
   Soils/sediments
   Air

* These constituents and associated analytical methods are given in the Laboratory's IWP (LANL 1991, 0553).

- surface water runoff and sediment transport of contaminants beyond the MDA J area of institutional control.

The specific data needed for characterization of the environmental setting of MDA J are given in Table 5.1-4.

5.1.3.1.3 Potential Public Health and Environmental Impacts

Because the nature of any contaminants released to the environment, if any, at MDA J has not been characterized, potential public health and environmental impacts are unknown. Phase I investigations will determine the nature of any contaminants released from pits and shafts at MDA J, and assess their migration from the area of institutional control via subsurface vapor phase transport, air transport, surface water runoff transport, and sediment transport. This will provide the information necessary to assess potential public health and environmental impacts from contaminants at MDA J.

Table 5.1-5 lists the data needed for receptor characterization.

5.1.3.2 MDA J Data Quality Objectives

The decision processes and data quality objectives (DQOs) described in this section are specific to MDA J SWMUs. The subsection format follows the more general process described in detail in Section 1.4 The reader is referred to Section 1.4 for definitions of terms and decision criteria, and to Figure 1.4-1 for the decision flow chart.

5.1.3.2.1 MDA J Decision Process

Decision Point 1:

On the basis of existing information, is there any potential risk to human health or the environment from the subsurface disposal units at MDA J?

Laboratory records indicate that only small quantities of hazardous waste or hazardous constituents were disposed of at MDA J.

Decision Point 2:

Is existing information sufficient to allow development of a Phase II sampling plan?

No. Existing laboratory records are incomplete. For this reason, a Phase I Sampling and Analysis Plan (SAP) will be executed at MDA J. As quantitative data become

TABLE 5.1-4
INFORMATION NEEDED FOR PHASE I TRANSPORT PATHWAY CHARACTERIZATION OF MDA J SUBSURFACE DISPOSAL UNITS

1. Surface Water Runoff Pathway

   Monthly Rainfall Averages
   Drainage Patterns
   Background Concentrations of Each Constituent

2. Soils/Sediments Pathway

   Respirable Dust Fraction
   Erodability
   Organic Carbon Content
   Moisture Content
   Background Concentration of Each Constituent

3. Air Pathway

   Wind Roses
   Wind Erosion Data
   Background Concentration of Each Constituent

4. Subsurface Migration Pathway

   Rock Mineralogy
   In Situ Air Permeability of Characteristic Rock Types
   Fracture Density
   Hydraulic Conductivity
   Background Concentration of Each Constituent

TABLE 5.1-5
INFORMATION NEEDED FOR PHASE I POTENTIAL RECEPTOR CHARACTERIZATION ACCORDING TO THE CONCEPTUAL MODEL FOR MDA J

1. General Land Use

   Present and possible future uses of MDA J:
   a. Waste disposal
   b. Closure with continued institutional control.

2. Human

   Human use of or access to MDA J and adjacent lands, including:
   a. Relationship between population centers and prevailing wind direction;
   b. Native American access to adjacent lands
   c. Recreational use access to adjacent land under management by Bandelier National Monument.

3. Demography

   A demographic profile of the people who use or have access to MDA J and adjacent land, including, but not limited to: age; sex; and sensitive subgroups. These receptor groups will be investigated if Phase II sampling is undertaken

4. Biota

   A description of the biota on, adjacent to, or affected by MDA J. These receptor groups will be investigated if Phase II sampling is undertaken.

5. Ecology

   A description of the ecology overlying and adjacent to MDA J will be provided if Phase II sampling is undertaken.

6. Endangered/Threatened Species

   A description of any endangered or threatened species near MDA J.

7. Risk Assessment
   The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 version of the Installation Work Plan. This approach will be developed in adequate time for data analysis

available, Phase I SAPs will be revised as appropriate. Data acquired in the Phase I investigation will serve as input to the next decision (Figure 1.4-1).

Decision Point 3:

Do the data collected in Phase I sampling confirm the presence of constituents of concern at MDA J?

This question is addressed by the DQO process for MDA J. The DQOs for Phase I SAPs follow the format of Section 1.4.3.1, and the diagram shown on Figure 1.4-2.

Problem Statement

It is not known whether constituents of concern are present at MDA J.

Questions to be Answered

Are there constituents of concern present in air, water, soils, sediments, or the subsurface which are above background levels or health risk-based action levels?

Decision Inputs/Data Needs for MDA J

Constituents of concern (COCs) in each transport medium for MDA J are summarized in Table 5.1-6. Volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and metals are specified in the Generic QAPjP (LANL 1991, 0412). Action levels for many of the constituents are available in proposed RCRA Subpart S.

No suite of radionuclides of concern (ROCs) is specified in Proposed RCRA Subpart S. The Phase I sampling plans include measurements of tritium, gross alpha and gross beta radioactivity, as well as gamma spectroscopy of samples.

Phase I SAPs were developed to determine the concentration of COCs in each environmental transport medium in the conceptual model (Figure 5.1-3).

Decision Domain

The spatial domain includes all of TA-54, MDA J, and excludes the adjacent canyons, which are addressed in OU 1049. The Laboratory will maintain institutional control over MDA J as discussed in Section 1.0.

TABLE 5.1-6
CONSTITUENTS OF CONCERN ADDRESSED IN ENVIRONMENTAL TRANSPORT MEDIA AT MDA J

Transport Media	Constituents of Concern[a]	Phase I SAP (Section Number)
Surface Water	SW-846[b] VOCs[c] SVOCs[d], metals, pesticides, PCBs[e], cyanide, ^3H, gross alpha, beta, gamma radioactivity	5.1.4.1
Surface Sediments	see above	5.1.4.2
Underground Soils (Cores)	see above	5.1.4.3
Air	VOCs	5.1.4.4
Soil	^3H	5.1.4.5

[a] Specific compounds are listed in the indicated SAP
[b] EPA 1983, 0288 for water; EPA 1987, 0518 for sediment and soil
[c] Volatile Organic Compounds
[d] Semivolatile Organic Compounds
[e] Polychlorinated biphenyls

Decision Rule/Logic Statement

The decision made at Decision Point 3 will be based on the following rule: If the concentration of any COC in any sample exceeds action levels or the natural background concentration, MDA J will be recommended for Phase II sampling.

The Phase I SAPs have been designed to determine the presence or absence of suspected COCs. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 version of the Installation Work Plan (IWP). This approach will be developed in adequate time for data analysis. The results of the Phase I SAPs for MDA J will be used to validate transport models, to provide initial health-risk estimates, and to develop more comprehensive Phase II SAPs.

Acceptable Uncertainty Limits

Because MDA J site and waste characterization data are lacking, it is not possible to determine true risk ranges and tolerance limits. The characterization data needed to develop Phase II SAPs and perform health risk-based assessments will be determined using the results of Phase I sampling, and the risk assessment approach which will be outlined in the 1992 IWP.

5.1.3.2.2 Approach to DQO Process

The Phase I sampling plans will rely on four levels of analytical data to determine precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters. The results of this determination will guide the development of the Phase II sampling plans. The four levels of analytical data to be used during Phase I sampling activities are

- Level I field screening to guide the selection of sampling locations for laboratory analyses;
- Level II field analyses to confirm Level I field screening results;
- Level III laboratory analyses for VOCs, SVOCs, metals, pesticides, polychlorinated biphenyls (PCBs), and cyanide; and
- Level V laboratory analyses at a laboratory with approved SOPs for gross alpha, gross beta, gamma spectroscopy, and tritium.

The pathways of concern at MDA J include surface water runoff, surface sediment transport, atmospheric dispersion, and subsurface migration of contaminants. It is important to characterize these pathways to determine if COCs are absent or present. If COCs are present and are found to be migrating beyond the boundaries of institutional control, a health risk-based assessment will be performed to develop potential response actions to meet the requirements of conditional remedy under RCRA Subpart S.

The health risk-based assessment will rely heavily on the data acquired during the Phase I and Phase II sampling and analysis activities at MDA J. The use of Level III and Level V data, described above, provides the required degree of accuracy, precision, and defensibility of data that are needed to assess risk to human health and the environment.

5.1.2.3 Phase I Field Investigation

Phase I data collection at MDA J is intended to accomplish the following:

- determine the presence or absence of contaminants released from disposal units at MDA J, if any;
- provide preliminary assessment of the extent of contaminant plumes, if any, in the subsurface; and
- assess potential contaminant migration pathways for transporting contaminants beyond the area of institutional control at MDA J.

5.1.3.2.4 Phase II Field Investigation

A complete Phase II sampling plan will be implemented, where necessary, following evaluation of the results of Phase I sampling and analysis. The Phase II sampling plans will be implemented to assess contaminant source and to further characterize the nature and extent of contamination so that appropriate response actions can be developed.

5.1.4 Sampling Plans

5.1.4.1 MDA J Surface Water Runoff Sampling

5.1.4.1.1 Sampling and Analysis Components

The purpose of collecting and analyzing surface water runoff samples from MDA J is to acquire technically accurate and legally defensible data to be used in site characterization and risk assessment. The data will be used to determine the potential for off-site migration of radionuclides or hazardous waste constituents in the waterborne pathway. The data will be validated according to the Environmental Protection Agency (EPA) functional guidelines for organic analysis (EPA 1988, 0293) and inorganic analysis (EPA 1988, 0296). Validation is necessary so that the quality of the data will be such that they can be used in risk assessment calculations. Currently, there are no published EPA methods for validating all radionuclide analyses.

5.1.4.1.2 Sampling and Analysis Approach

This SAP is designed to obtain information on contaminant concentrations and contaminant transport in the environment around MDA J at TA-54 that will support DQO decisions. One of the primary transport mechanisms from MDA J is surface water runoff during heavy storms; therefore, sampling will take place in the primary runoff pathway at MDA J.

5.1.4.1.3 Primary Data Quality Factors

5.1.4.1.3.1 Prioritized Data Uses

The data to be collected are necessary for site characterization and risk assessment.

- Site Characterization - Only anecdotal information is available for MDA J. Data will be collected to verify the absence or presence of the regulated VOCs and SVOCs, metals, pesticides, PCBs, cyanide, tritium, gross alpha, gross beta, or gamma emitters.

- Risk Assessment - The chemical source term for MDA J is not fully understood. The source term was characterized primarily by literature review only. Collected data will be used for health risk-based assessment.

5.1.4.1.3.2 Appropriate Analytical Levels

Samples collected will be screened in the field and analyzed in a laboratory using EPA SW-846 (third edition) protocol. Photoionization Detectors (PIDs) and Flame Ionization Detectors (FIDs) will be used in the field to screen for organic vapors; and alpha, beta, and gamma survey instruments will be used for field screening ionizing radiation. The levels of analysis are

Level I Field Screen: PID/FID screen instruments; alpha, beta, gamma survey instruments,

Level II Field Analysis: Gas Chromatography (GC) with either a PID, FID, or Electron Capture Detector (ECD),

Level III SW-846 Laboratory Methods, and

Level V Radionuclide Analysis Laboratory Methods.

5.1.4.1.3.3 Primary Contaminants of Concern

The contaminants of concern at MDA J are VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, gross alpha, gross beta, and gamma emitters.

5.1.4.1.3.4 Levels of Concern

Appendix F of the IWP (LANL 1991, 0553) and 40 CFR 264, Proposed Subpart S, contain information on constituent levels of concern. Health risk-based determinations of levels of concern will be developed for constituents not listed in Appendix F. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 IWP. This approach will be developed in adequate time for data analysis.

5.1.4.1.3.5 Required Quantitation Limits

Quantitation limits for laboratory analysis of hazardous and radioactive constituents in water are given in Tables V.3 through V.9 of the Laboratory's Generic QAPjP (LANL 1991, 0412). Analytical methods used for surface water runoff samples at MDA J will fall in the range of these quantitation limits. The quantitation limits will be the current SW-846 protocol for VOCs, SVOCs, pesticides, PCBs, cyanide, and metals. Level V analysis for tritium, gross alpha, gross beta, and gamma emitters will use the current Laboratory-approved analytical contractor or EM-9.

5.1.4.1.3.6 Critical Samples

A surface water sample collected in the primary drainage channel during a heavy storm is a critical sample because it represents potential transport beyond institutional control.

5.1.4.1.4 Rationale for Sampling Activity

The rationale for surface water runoff sampling from the drainage area is to:

- determine if VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, gross alpha, gross beta, and gamma emitters are being discharged from MDA J;
- further define source terms;
- collect data that can be used to support and supplement existing data for the DQO process; and
- collect data that can be used in a risk assessment.

5.1.4.1.5 Sampling Activity

One surface water runoff sample will be collected from the primary discharge point during Phase I sampling. The results will be compared to the Laboratory's Environmental Surveillance Program results (Environmental Protection Group 1990, 0497). The sampling location is shown on Figure 5.1-4. Table 5.1-7 summarizes the number of samples, the number of quality control (QC) samples, and the analytical requirements for Phase I sampling. It also describes the types of required QC samples. Surface water runoff sampling procedures are presented in Section 1.0 of Appendix B.

5.1.4.1.6 Remaining SAP Elements

The remaining required elements of this SAP are common to all of the SAPs prepared for OU 1148. These common elements are listed in Table 5.1-8, and are located in Appendix B of this RFI Work Plan.

5.1.4.1.7 Phase II SAP

If the results of Phase I surface water runoff sampling indicate that COCs exceed health risk-based criteria, then Phase II sampling will be conducted at MDA J. Surface soil samples will be collected at the locations of the passive air collection sites and analyzed for the COCs that exceeded the health risk-based criteria in the surface water runoff sample (see Section 5.1.4.4 for the passive air sample collection locations). Table 5.1-9 summarizes the number of samples and analytical requirements for the Phase II sampling activities.

5.1.4.1.8 Health and Safety

This SAP will follow procedures outlined in the Laboratory's Environment, Safety and Health Manual (LANL 1990, 0335) and Annex III of this RFI Work Plan.

5.1.4.1.9 Schedule

See Annex I.

5.1.4.2 MDA J Surface Sediment Sampling

5.1.4.2.1 Sampling and Analysis Components

The purpose of collecting and analyzing surface sediment samples from MDA J is to accumulate technically accurate and legally defensible data. The data will be used to determine the potential for off-site migration of radionuclides or hazardous waste constituents in the sediment pathway. The data will be validated according to the EPA functional guidelines for organic analysis (EPA 1988, 0293) and inorganic

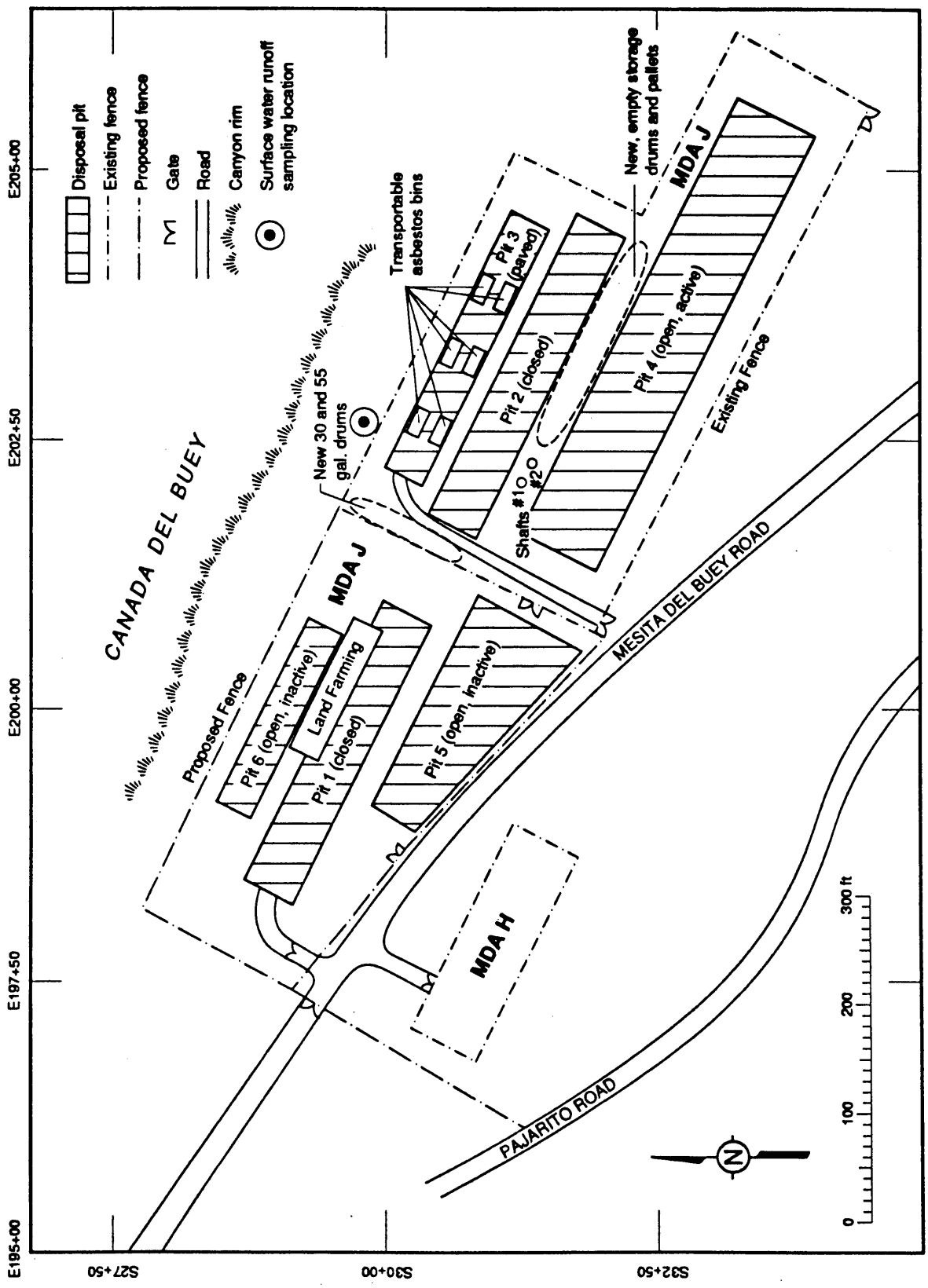

Figure 5.1-4 Surface water runoff sampling location at MDA J.

TABLE 5.1-7
PHASE I SAMPLING AND ANALYSIS PLAN TABLE FOR SURFACE WATER RUNOFF SAMPLING AT MDA J

Media	# of Samples	# of QC[a] Samples	Total Samples	Analysis
Water	1	4	5	VOCs SVOCs Metals Pesticides PCBs Cyanide Tritium Gross Alpha Gross Beta Gamma Spectroscopy

[a] Includes Trip Blank, Field Blank, Duplicate Sample, and Equipment (Rinsate) Blank.

Trip Blank: Two 40 ml VOC sample containers filled with organic-free water at the Sample Coordination Facility. Filled trip blanks accompany sample bottles to the field, remain unopened throughout the sampling activity, and return with shipment to the analytical laboratory. Submitted only when sampling for VOCs.

Field Blank: Organic-free water is poured into sample containers at the sampling site.

Duplicate Sample: Collect two separate surface water runoff samples simultaneously.

Equipment (Rinsate) Blank: Obtained by running organic-free water over cleaned, decontaminatedsampling equipment. Rinse the equipment surface that comes into contact with a sample.

TABLE 5.1-8
FIELD SAMPLING PLAN ELEMENTS LOCATED IN APPENDIX B

1. Sample Collection Procedures
2. Field Documentation
3. Sample Preservation and Handling Procedures
4. Field Quality Assurance
5. Variance Situation
6. Equipment List
7. Equipment Calibration
8. Decontamination Procedures
9. Precision, Accuracy, Representativeness, Completeness, and Comparability Review

TABLE 5.1-9
PHASE II SURFACE WATER RUNOFF (SOIL) SAMPLING AT MDA J

Media	Phase II Sampling	Rationale	Analysis	# of Samples
Soil	13 locations	Sample if COCs exceed health risk-based critieria during Phase I sampling.	COCs	13 + 4 QCs 17 Total

analysis (EPA 1988, 0296). Validation is necessary so that the quality of the data will be such that they can be used in risk assessment calculations. Currently, there are no published EPA methods for validating all radionuclide analyses.

5.1.4.2.2 Sampling and Analysis Approach

This SAP is designed to obtain information on contaminant concentrations and contaminant transport in the environment around MDA J at TA-54 that will support DQO decisions. One of the primary sediment transport mechanisms from MDA J is surface water runoff during heavy rainstorms; therefore, sediment sampling will take place in the primary runoff area at MDA J.

5.1.4.2.3 Primary Data Quality Factors

5.1.4.2.3.1 Prioritized Data Uses

The data to be collected are necessary for site characterization and risk assessment.

- Site Characterization - Only anecdotal information is available for MDA J. Data will be collected to verify the absence or presence of the regulated VOCs and SVOCs, metals, pesticides, PCBs, cyanide, tritium, gross alpha, gross beta, and gamma emitters.

- Risk Assessment - The chemical source term for MDA J is not fully understood. The source term was characterized primarily by literature review only. It is not known whether the source may generate vapors as buried containers lose integrity. Collected data will be used for health risk-based assessment.

5.1.4.2.3.2 Appropriate Analytical Levels

Samples collected will be screened in the field and analyzed in a laboratory using EPA SW-846 (third edition) protocol. PIDs and FIDs will be used in the field to screen for organic vapors, and alpha, beta, and gamma survey instruments will be used for field screening ionizing radiation. The levels of analysis are

Level I Field Screen: PID/FID screen instruments; alpha, beta, gamma survey instruments,

Level II Field Analysis: GC with either a PID, FID, or ECD,

Level III SW-846 Laboratory Methods, and

Level V Radionuclide Analysis Laboratory Methods.

5.1.4.2.3.3 Primary Contaminants of Concern

The contaminants of concern at MDA J are VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, and gross alpha, gross beta, and gamma emitters.

5.1.4.2.3.4 Levels of Concern

Appendix F of the IWP (LANL 1991, 0553) and 40 CFR 264, Proposed Subpart S, contain information on constituent levels of concern. Health risk-based determinations of levels of concern will be developed for constituents not listed in Appendix F. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 IWP. This approach will be developed in adequate time for data analysis.

5.1.4.2.3.5 Required Quantitation Limits

Quantitation limits for laboratory analysis of hazardous and radioactive constituents in soil are given in Tables V.3 through V.9 of the Laboratory's Generic QAPjP (LANL 1991, 0412). Analytical methods used for surface sediment samples at MDA J will fall in the range of these quantitation limits. The quantitation limits will be the current SW-846 protocol for VOCs, SVOCs, metals, pesticides, PCBs, and cyanide. Level V analysis for tritium, gross alpha, gross beta, and gamma emitters will use the current Laboratory-approved analytical contractor or EM-9.

5.1.4.2.3.6 Critical Samples

Surface sediment samples collected from the primary drainage channel beyond the fence line are critical samples because they represent potential transport beyond institutional control.

5.1.4.2.4 Rationale for Sampling Activity

The rationale for surface sediment sampling from the drainage area is to:

- determine if VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, gross alpha, gross beta, and gamma emitters are being discharged from MDA J;
- further define source terms;
- collect data that can be used to support and supplement existing data for the DQO process; and
- collect data that can be used in a risk assessment.

5.1.4.2.5 Sampling Activity

One set of nine surface sediment samples will be collected from the primary runoff area at MDA J during Phase I sampling. The results will be compared to the Laboratory's Environmental Surveillance Program results (Environmental Protection Group 1990, 0497). Table 5.1-10 summarizes the number of grab samples, the number of QC samples, and the analytical requirements for the Phase I surface sediment sampling. Surface sediment sampling procedures are presented in Section 2.0 of Appendix B.

Figure 5.1-5 shows the location of the drainage basin to be sampled. The drainage basin has been divided into a 3- by 20-ft grid, and nine sample locations were randomly selected. The sample grid and the randomly selected sample points are also shown on Figure 5.1-5. The shape of the grid is long and narrow to reflect the geomorphic drainage features.

5.1.4.2.6 Remaining SAP Elements

The remaining required elements of this SAP are common to all of the SAPs prepared for OU 1148. These common elements are listed in Table 5.1-8 and are located in Appendix B of this RFI Work Plan.

5.1.4.2.7 Phase II SAPs

Phase II sampling of surface sediment will be conducted at MDA J to determine the vertical and lateral extent of contamination if Phase I sampling results indicate that concentrations of COCs exceed health risk-based criteria. Composite samples will be collected from a depth of 6-12 in at the nodes where COCs exceeded health risk-based criteria. If Phase II sampling is required, then three additional samples from the talus slope just north of the drainage channel will also be collected. In addition, soil samples will be collected at the passive air sampling locations inside the MDA (11 locations) and analyzed for the COCs that exceeded the health risk-based criteria in the sediment sample (see Section 5.1.4.4 for the passive air sample locations). Table 5.1-11 summarizes the Phase II surface sediment sampling program for MDA J.

5.1.4.2.8 Health and Safety

This SAP will follow the procedures outlined in the Laboratory's Environment, Safety and Health Manual (LANL 1990, 0335) and Annex III of this RFI work plan.

5.1.4.2.9 Schedule

See Annex I.

TABLE 5.1-10
PHASE I SAMPLING AND ANALYSIS PLAN TABLE FOR SURFACE SEDIMENT SAMPLING AT MDA J

Media	# of Samples	# of QC[a] Samples	Total Samples	Analysis
Soil	9	4	13	VOCs SVOCs Metals Pesticides PCBs Cyanide Tritium Gross Alpha Gross Beta Gamma Spectroscopy

[a] Includes Trip Blank, Field Blank, Duplicate Sample, and Equipment (Rinsate) Blank.

Trip Blank: Two 40 ml VOC sample containers filled with organic-free water at the Sample Coordination Facility. Filled trip blanks accompany sample bottles to the field, remain unopened throughout the sampling activity, and return with shipment only when sampling for VOCs.

Field Blank: Organic-free water is poured into sample containers at the sampling site.

Duplicate Sample: Collect two separate water samples simultaneously.

Equipment (Rinsate) Blank: Obtained by running organic-free water over cleaned, decontaminated sampling equipment. Rinse the equipment surface that comes into contact with a sample.

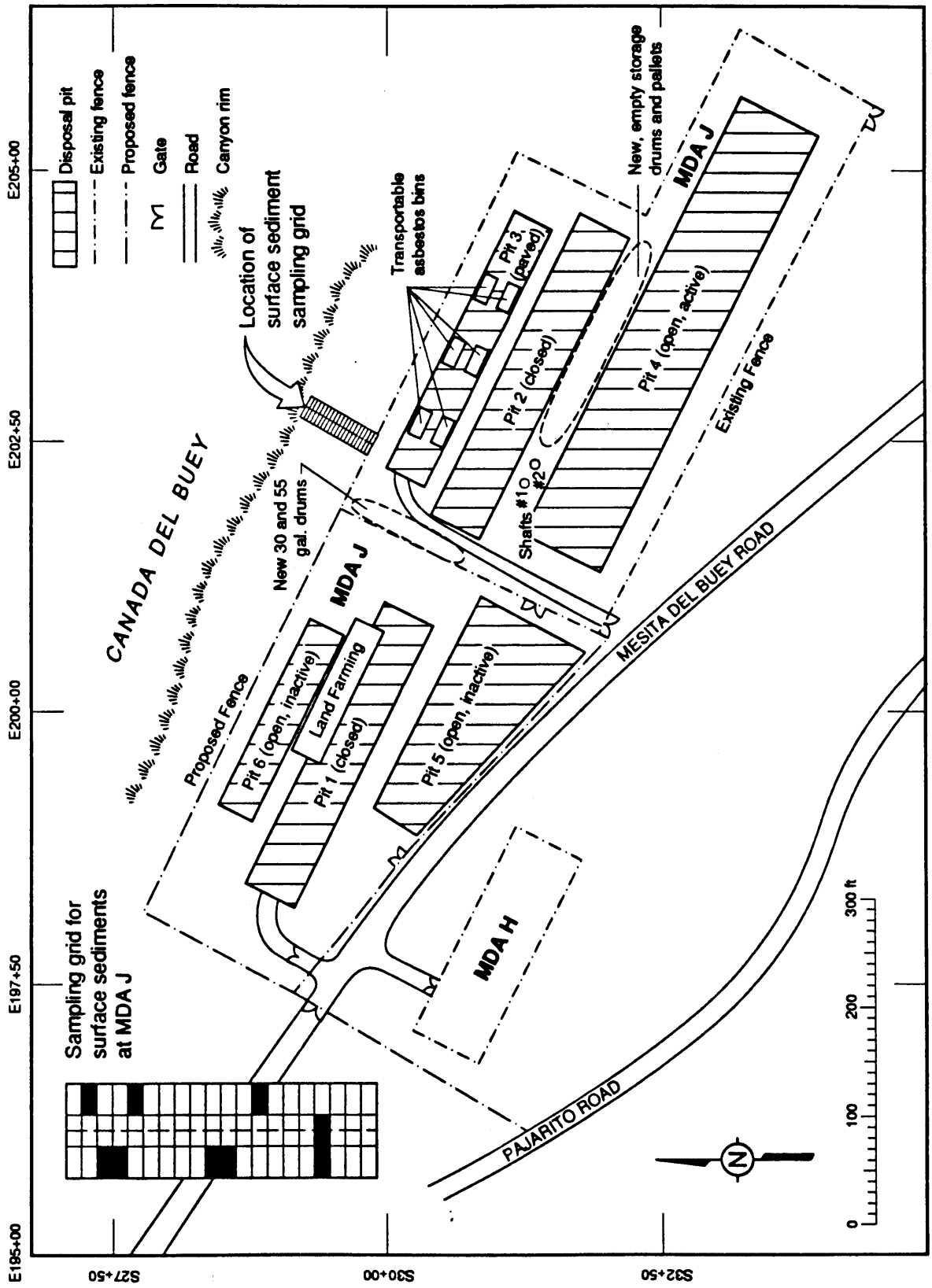

Figure 5.1-5 Surface sediment sampling location at MDA J.

TABLE 5.1-11
PHASE II SURFACE SEDIMENT SAMPLING
AT MDA J

Media	Phase II Sampling	Rationale	Analysis	# of Samples
Soil	23 locations	Sample if COCs exceed health risk-based criteria during Phase I sampling.	COCs	23 + 8 QCs 31 Total

5.1.4.3 Vertical and Angled Borehole Sampling at MDA J

5.1.4.3.1 Sampling and Analysis Components

The purpose of collecting and analyzing samples from the vertical and angled boreholes at MDA J is to obtain technically accurate and legally defensible data which can be used to determine the absence or presence of contamination at MDA J. The sampling component of this task consists of drilling one vertical and one angled borehole to collect continuous rock core samples and soil gas samples for chemical and radiological analyses. The analytical component consists of field and laboratory analysis of rock core and soil gas samples. Soil gas samples will be screened in the field for VOCs. Rock core samples will be screened in the field for VOCs and gross alpha, gross beta, and gross gamma ionizing radiation. Analysis at a Laboratory-contracted analytical laboratory will be conducted on core samples for VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, and gross alpha, gross beta, and gamma emitters. Soil gas samples will be analyzed for VOCs. The data will be validated according to EPA functional guidelines for organic analysis (EPA 1988, 0293) and inorganic analysis (EPA 1988, 0296). Validation is necessary so that the quality of data will be such that they can be used in risk assessment calculations. Currently, there are no published EPA methods for validating all radionuclide analyses.

5.1.4.3.2 Sampling and Analysis Approach

A phased drilling approach will be used to characterize subsurface contamination at MDA J. Rock core and soil gas samples will be collected from the proposed Phase I boreholes at MDA J. A continuous suite of rock core samples will be collected using hollow stem auger drilling techniques. Soil gas samples will be collected from sections of each borehole that are isolated by a packer. Grab samples of soil gas will be collected using either the TO-14 gas canister method (SUMMA®) or the resin tube method currently under development by LANL's EM-9 Group.

Rock core and soil gas samples will be shipped to a laboratory for analysis. All analyses for hazardous constituents will be performed according to EPA SW-846 (third edition) protocol. Analyses with tentatively identified compounds (TICs) will be reported in Level III SW-846 packages for subsequent data validation. Level V analysis for tritium, gross alpha, gross beta, and gamma emitters will use the current Laboratory-approved analytical contractor or EM-9.

5.1.4.3.3 Primary Data Quality Factors

5.1.4.3.3.1 Prioritized Data Uses

The data to be collected are necessary for site characterization and risk assessment.

- Site Characterization - Only anecdotal information is available for MDA J. Data will be collected to verify the absence or presence of the regulated

VOCs and SVOCs, metals, pesticides, PCBs, cyanide, tritium, gross alpha, gross beta, and gamma emitters.

- Risk Assessment - The chemical source term for MDA J is not fully understood. The source term was characterized primarily by literature review only. It is not known whether the source may generate vapors as buried containers lose integrity. Collected data will be used for health risk-based assessment.

5.1.4.3.3.2 Appropriate Analytical Levels

Samples collected will be screened in the field and analyzed in a laboratory using SW-846 protocol. PIDs, FIDs, and ECDs will be used in the field to screen for organic vapors immediately after samples have been collected. A field GC, in a mobile laboratory, will be used along with a PID or FID to determine qualitatively the hazardous constituents present.

Radiological screening of samples will be conducted for gross beta and gamma radioactivity and gross alpha contamination. Screening for gross beta and gamma radiation will be conducted with a hand-held sodium iodide detector (NaID) probe and rate meter, or equivalent system. Screening for gross alpha contamination will be conducted with a hand-held alpha scintillation detector (ASD) and rate meter, or equivalent system. A windowless gas flow proportional (GFP) counter and a liquid scintillation counter in a mobile laboratory will be used for radiological screening, in addition to screening with the hand-held detectors. Below are the levels of analysis.

Level I Field Screen: PID/FID Instruments; NaID/ASD Instruments,

Level II Field Analysis: Field GC with a PID/FID/ECD; Liquid Scintillation Counter; Windowless GFP Counter,

Level III SW-846 Laboratory Methods, and

Level V Radionuclide Analysis Laboratory Methods.

5.1.4.3.3.3 Primary Contaminants of Concern

The primary contaminants of concern at MDA J are VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, gross alpha, gross beta, and gamma emitters.

5.1.4.3.3.4 Levels of Concern

Appendix F of the Laboratory's IWP (LANL 1991, 0553) and 40 CFR 264, Proposed Subpart S, contain information on constituent levels of concern. Health risk-based determinations of levels of concern will be developed for constituents not listed in Appendix F. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 IWP. This approach will be developed in adequate time for data analysis.

5.1.4.3.3.5 Required Quantitation Limits

Quantitation limits for laboratory analysis of hazardous substances and radionuclides are presented in Tables V.3 through V.9 of the Laboratory's Generic QAPjP (LANL 1991, 0412).

5.1.4.3.3.6 Critical Samples

Samples collected from the angled borehole east of Pit 1 are critical in determining whether migration has occurred from Pit 1. Likewise, samples collected from the vertical borehole east of Pit 2 are important in determining migration from Pit 2. Pit 1 and Pit 2 are the oldest pits at MDA J, and the least is known about constituents and constituent volumes which may have been disposed of in them. The proposed borehole and soil gas sampling will provide information on surface and subsurface migration from MDA J.

5.1.4.3.4. Rationale for Sampling Activity

The rationale for installing the two boreholes at MDA J is:

- to determine whether there are subsurface contaminant plumes originating from Area J; and
- to provide a preliminary assessment of the nature and extent of contaminant plumes at Area J, if they exist.

This information will be obtained through the following sampling tasks:

Task 1. Borehole Installation

- A vertical borehole will be drilled east of Pit 2 to confirm absence or presence of the migration of target contaminants from this pit area (see Figure 5.1-6 for proposed borehole location).
- An angled borehole will be drilled east of Pit 1 to confirm absence or presence of the migration of target contaminants from this pit area (see Figure 5.1-6 for proposed borehole location).
- Core samples will be collected and analyzed for VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, gross alpha, gross beta, and gamma emitters.
- Soil vapors will by screened in the field through the use of a PID and FID.

Task 2. Vapor Sampling

- Vapor sampling to collect soil gas will be conducted within the boreholes as they are advanced. Following collection of the samples, boreholes will be grouted and abandoned.

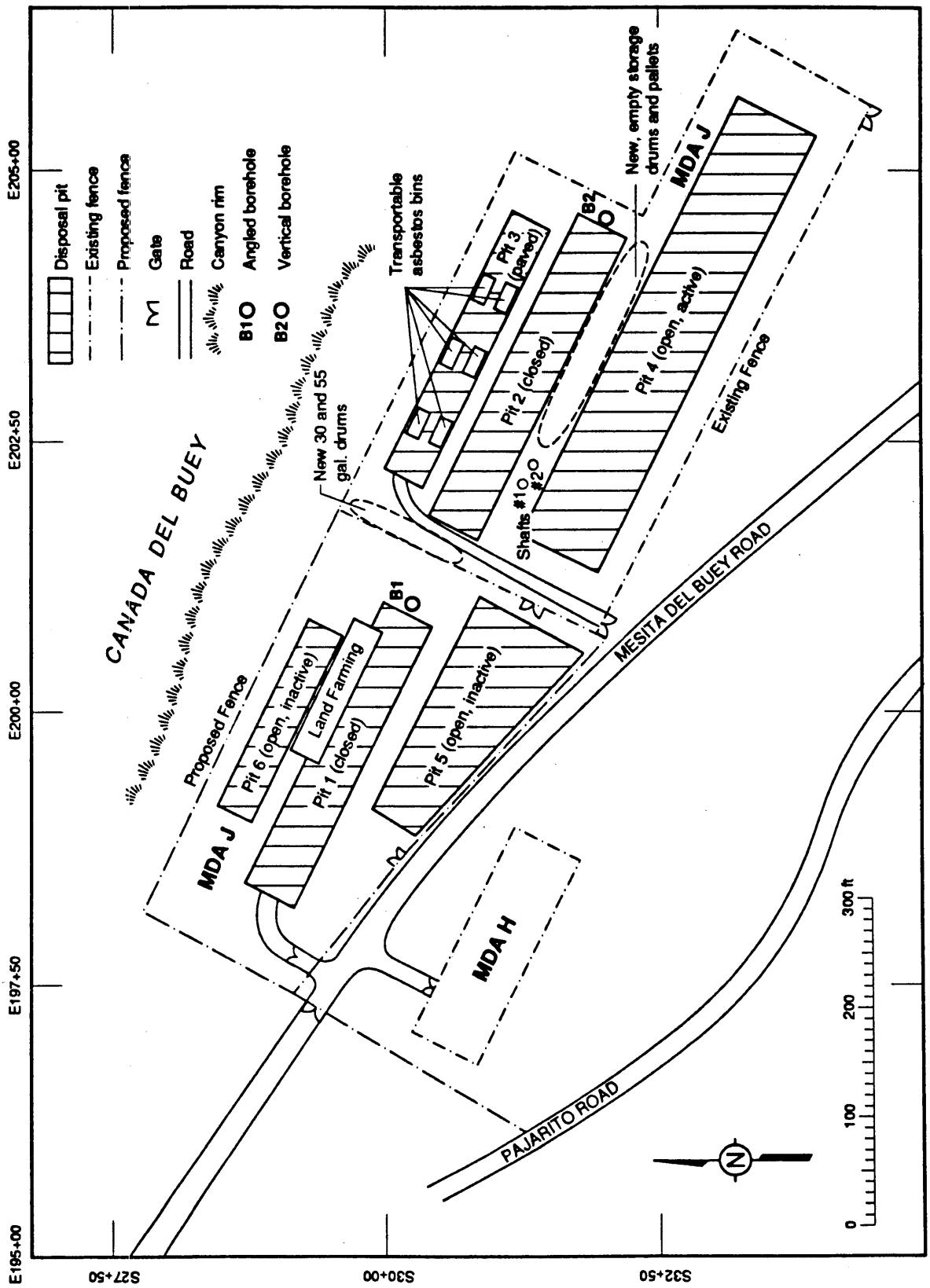

Figure 5.1-6 Angled and vertical borehole locations at MDA J.

- Soil gas samples will be collected using resin tubes or SUMMA® canisters and analyzed for VOCs using SW-846 protocol (third edition).

5.1.4.3.5 Sampling Activity

5.1.4.3.5.1 Boreholes at MDA J

One vertical and one angled borehole will be drilled during the Phase I sampling program. Information obtained from the boreholes will be used to determine if contaminant migration has occurred from Pits 1 and 2 at MDA J. The vertical borehole will be advanced to a depth of 70 to 80 ft (total pit depth is 17 ft). Soil gas samples will be collected every 20 ft using down-hole packers within the augers to isolate the sample interval. The angled borehole will be drilled at an incline of 30° from vertical to a borehole length of 80 ft. The advancement of the auger will begin approximately 15 ft from the east side of Pit 1. If the pit is encountered, the boring will be grouted and a new borehole will be advanced at a distance further away from the pit boundary. The actual depth of the boreholes may vary depending on the results of field analysis on cores and soil vapors. Both boreholes will continue to be advanced until no hazardous contaminants are detected by field observation and instrumentation (e.g., PID, FID, GC).

Proposed borehole locations are shown on Figure 5.1-6. Both the vertical and angled boreholes will be advanced by hollow stem auger (HSA) techniques using a Failing Model F-10, or equivalent drill rig. Boreholes will be advanced with 7.625-in outside diameter by 4.25-in inside diameter augers. Soil samples will be collected with a 3.25-in inside diameter, 5-ft-long split barrel continuous sampling tube. A wireline retrieval system will be used to return the sampling tube to the surface.

Table 5.1-12 is a sampling summary of the vertical and angled boreholes at MDA J. It lists the sampling interval for each media along with the analyses to be performed and the corresponding analytical level. A detailed tabulation of sample intervals and corresponding analyses for each borehole is presented in Table B.3-1 of Appendix B. The ratio for quality control (QC) samples for sample collection activities is presented in Table B.10-1 of Appendix B. Table 5.1-13 summarizes the number of samples, the number of QC samples, and the analytical requirements for Phase I borehole sampling at MDA J, and explains the types of QC samples required.

The procedures for borehole drilling and logging, sample (rock core) collection from the boreholes, field screening analyses, hydrogeologic measurements, downhole geophysical surveys, waste disposal, and borehole abandonment are described in Section 3.0 of Appendix B. Soil gas sampling procedures, surveying, and field screening procedures are presented in Appendix B, Section 6.0.

5.1.4.3.6 Remaining SAP Elements

The remaining required elements of this SAP are common to all of the SAPs prepared for OU 1148. These common elements are listed in Table 5.1-8 and are located in Appendix B of this RFI work plan.

TABLE 5.1-12
SAMPLING SUMMARY FOR VERTICAL BOREHOLES AT MDA J

Analytical Level	Sampling[a] Interval	Analysis	Medium
Laboratory Analysis			
Level III	20 ft	VOCs	Rock Core
Level III	20 ft	SVOCs	Rock Core
Level III	20 ft	Metals	Rock Core
Level III	20 ft	Pesticides, PCBs, Cyanide	Rock Core
Level V	20 ft	Gross Alpha and Beta, Gamma Spectroscopy	Rock Core
Level III	20 ft	VOCs	Vapor
Level V	20 ft	Tritium	Rock Core
Field Screening or Analysis			
Level I	5 ft	Organic Vapors (PID/FID)	Rock Core
Level II	5 ft	Organic Vapors (Field GC)	Rock Core
Level I or II	5 ft	Alpha, Beta, & Gamma Emissions	Rock Core
Level II	5 ft	Gravimetric Moisture	Rock Core

SAMPLING SUMMARY FOR ANGLED BOREHOLES AT MDA J

Laboratory Analysis			
Level III	10 ft	VOCs	Rock Core
Level III	10 ft	SVOCs	Rock Core
Level III	10 ft	Metals	Rock Core
Level III	10 ft	Pesticides, PCBs, Cyanide	Rock Core
Level V	10 ft	Gross Alpha and Beta, Gamma Spectroscopy	Rock Core
Level III	10 ft	VOCs	Vapor
Level V	10 ft	Tritium	Rock Core
Field Screening or Analysis			
Level I	5 ft	Organic Vapors (PID/FID)	Rock Core
Level II	5 ft	Organic Vapors (Field GC)	Rock Core
Level I or II	5 ft	Alpha, Beta, & Gamma Emissions	Rock Core

a A sample will be collected at a minimum spacing of 20 ft for analyses to confirm the absence or presence of COCs above the health risk-based criteria. The actual depth of the sample will be determined from the field screening and observations.

TABLE 5.1-13
PHASE I SAMPLING AND ANALYSIS PLAN TABLE FOR VERTICAL AND ANGLED BOREHOLE SAMPLING AT MDA J

Media	# of Samples	# of QC[a] Samples	Total Samples	Analysis
Rock Core	15	16	31	VOCs SVOCs Metals Pesticides PCBs Cyanide Gross Alpha Gross Beta Gamma Spectroscopy
Soil Gas	15	16	31	VOCs

[a] Includes: Trip Blank, Field Blank, Duplicate Sample, and Equipment (Rinsate) Blank.

Trip Blank (Soil/Rock Core): Two 40 ml VOC sample containers filled with organic-free water at the Sample Coordination Facility. Filled trip blanks accompany sample bottles to the field, remain unopened through the sampling activity, and return with shipment to the analytical laboratory. Submitted only when sampling for VOCs.

Trip Blank (Soil Gas): A sealed SUMMA® canister or resin tubes taken to the field during a sampling event and returned with shipment to the analytical laboratory. Canister or resin tubes remain unopened.

Field Blank (Soil/Rock Core): Organic-free water is poured into sample containers at the site of the borehole sampling.

Field Blank (Soil Gas): A SUMMA® canister or resin tubes are exposed to the atmosphere near the sampling site. The canister or resin tubes will be left open until 3 liters of air are sampled.

Duplicate Samples (Soil/Rock Core): Collect two separate core samples immediately adjacent to each other by the same sampling technique.

Duplicate Samples (Soil Gas): Obtained by attaching two SUMMA® canisters or four resin tubes to the sample line with a Y fitting and filling the canisters or tubes simultaneously.

Equipment (Rinsate) Blanks (Soil/Rock Core): Obtained by running organic-free water over cleaned, decontaminated sampling equipment. Rinse the equipment surface that comes into contact with a sample.

Equipment (Rinsate) Blanks (Soil Gas): A soil gas sample, using a SUMMA® canister or resin tubes, is taken to assess the cleanliness of the sample manifold. Clean the sample manifold, fill a 6L Teflon® bag with zero-zero air, and attach the bag and a canister or resin tubes to the manifold. Collect 3 liter using a flow rate of 500 ml/minute.

5.1.4.3.7 Phase II SAP

No additional angled boreholes will be drilled beneath Pit 1. Two additional vertical borings may be needed to further characterize migration of contaminants away from the MDA if COCs are detected in the subsurface during Phase I sampling. Table 5.1-14 summarizes the Phase II sampling and analytical requirements.

5.1.4.3.8 Health and Safety

This SAP will follow the procedures outlined in the Laboratory's Environment, Safety and Health Manual (LANL 1990, 0335) and Annex III of this RFI work plan.

5.1.4.3.9 Schedule

See Annex I.

5.1.4.4 Passive Air Sampling at MDA J

5.1.4.4.1 Sampling and Analysis Components

The purpose of collecting and analyzing passive air samples at MDA J is to accumulate technically accurate and legally defensible data. The data will be used to characterize the nature, type, and extent of contamination by VOCs at MDA J, if any. This information will be used in the Phase I assessment to determine the flux rate of VOCs emanating from MDA J.

The sampling components will consist of collection of passive air samples at the ground surface using EMFLUX® sample cartridges. The analysis component will consist of VOC analysis by Quadrel Services Inc. The data will be validated according to the EPA functional guidelines for organic analysis (EPA 1988, 0293).

5.1.4.4.2 Sampling and Analysis Approach

Soil gas will be sampled using EMFLUX® sample cartridges, which are stainless steel mesh and wire cartridges containing approximately 100 mg of selected adsorbent material. The sample cartridges will be placed at surveyed sampling points on a predetermined grid. Cartridges will be exposed to the soil for a period of 72 hours in order to capture soil gas by passive adsorption. To increase survey sensitivity and accuracy, the EMFLUX® system is designed to take maximum advantage of the phenomenon known as earth tides, the dominant geophysical forces governing vertical movement of trace gases through the earth's crust. Variation in barometric pressure is also important to outgassing of soil gas to the atmosphere. Therefore, during the sampling period, a recording barometer will be used to record the barometric pressure on site. Wind speed data will also be collected from the MDA

TABLE 5.1-14
PHASE II BOREHOLE SAMPLING AT MDA J

Media	Phase II Sampling	Rationale	Analysis	# of Samples
Rock Core	2 locations	Sample to further characterize subsurface if COCs exceed health risk-based criteria in Phase I.	COCs	12 + 16 QCs 28 Total
Soil Gas	See above.	See above.	VOCs	12 + 16 QCs 28 Total

G weather tower. The samples will be sent to the Sample Coordination Facility (SCF), where they will be shipped to Quadrel Services Inc. environmental laboratories for analysis. The analysis to be performed include VOCs, following EPA SW-846 (third edition) protocol, with a ten compound library search and tentatively identified compounds (TICs).

5.1.4.4.3 Primary Data Quality Factors

5.1.4.4.3.1 Prioritized Data Uses

The data to be collected are needed for site characterization and risk assessment. Each stage of data collection and use is outlined below.

- Site Characterization - Only anecdotal information is available for MDA J. Data will be collected to verify the absence or presence of the regulated VOCs.

- Risk Assessment - The chemical source term for MDA J is not fully understood. The source term was characterized primarily by literature review only. It is not known whether the source may generate vapors as buried containers lose integrity. Collected data will be used for health risk-based assessment.

5.1.4.4.3.2 Appropriate Analytical Levels

Immediately after scoring the soil for placement of the sample cartridge, the soil surface will be screened for organic vapors with PIDs, FIDs, or ECDs. Screening for radionuclides will be conducted with a hand-held ASD for gross alpha contamination, and a hand-held NaID for gamma radioactivity. The various analytical levels established for this sampling plan are as follows:

Level I Field Screen: PID/FID Instruments; NaID/ASD instruments,

Level II Field Analysis: GC with a PID/FID/ECD; Liquid Scintillation Counter; Windowless GFP Counter, and

Level III SW-846 Laboratory Methods.

5.1.4.4.3.3 Primary Contaminants of Concern

The primary contaminants of concern at MDA J for this sampling activity are VOCs.

5.1.4.4.3.4 Levels of Concern

Appendix F of the IWP (LANL 1991, 0553) and 40 CFR 264, Proposed Subpart S, contain information on constituent levels of concern. Health risk-based determinations of levels of concern will be developed for constituents not listed in Appendix F. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 IWP. This approach will be developed in adequate time for data analysis.

5.1.4.4.3.5 Required Quantitation Limits

Quantitation limits are not established for soil gas vapor monitoring. Table V.3 of the Laboratory's Generic QAPjP, however, gives quantitation limits for laboratory analysis of VOCs in soil (LANL 1991, 0412).

5.1.4.4.3.6 Critical Samples

Samples collected at the surface of MDA J are important in determining the nature and extent of potential VOC contamination.

5.1.4.4.4 Rationale For Sampling Activity

The rationale for passive air sampling at MDA J is to:

- measure the flux entering the atmospheric pathway, if any;
- characterize the VOC source term; and
- determine if VOCs are present in the subsurface at MDA J by using an inexpensive means of multiple sampling.

All of the data obtained through implementation of this SAP will be used for further site characterization. This information will be obtained through the following tasks:

Task 1. Grid Layout and Sample Point Designation

The EPA "Field Manual for Grid Sampling of PCB Spill Sites to Verify Cleanup" (MRI Grid System) (1986, 0645) was used in determining the grid layout and sample point designation for the passive air sampling task in MDA J. The manual provides guidance for designing hexagonal sampling grids which represent a statistically valid method for determining the extent of contamination from a chemical release. Figure 5.1-7 shows the points to be sampled.

Task 2. Source Term Characterization

Passive surface air sampling will be performed by placing EMFLUX® cartridges in locations determined using the EPA MRI Grid System. The canisters will

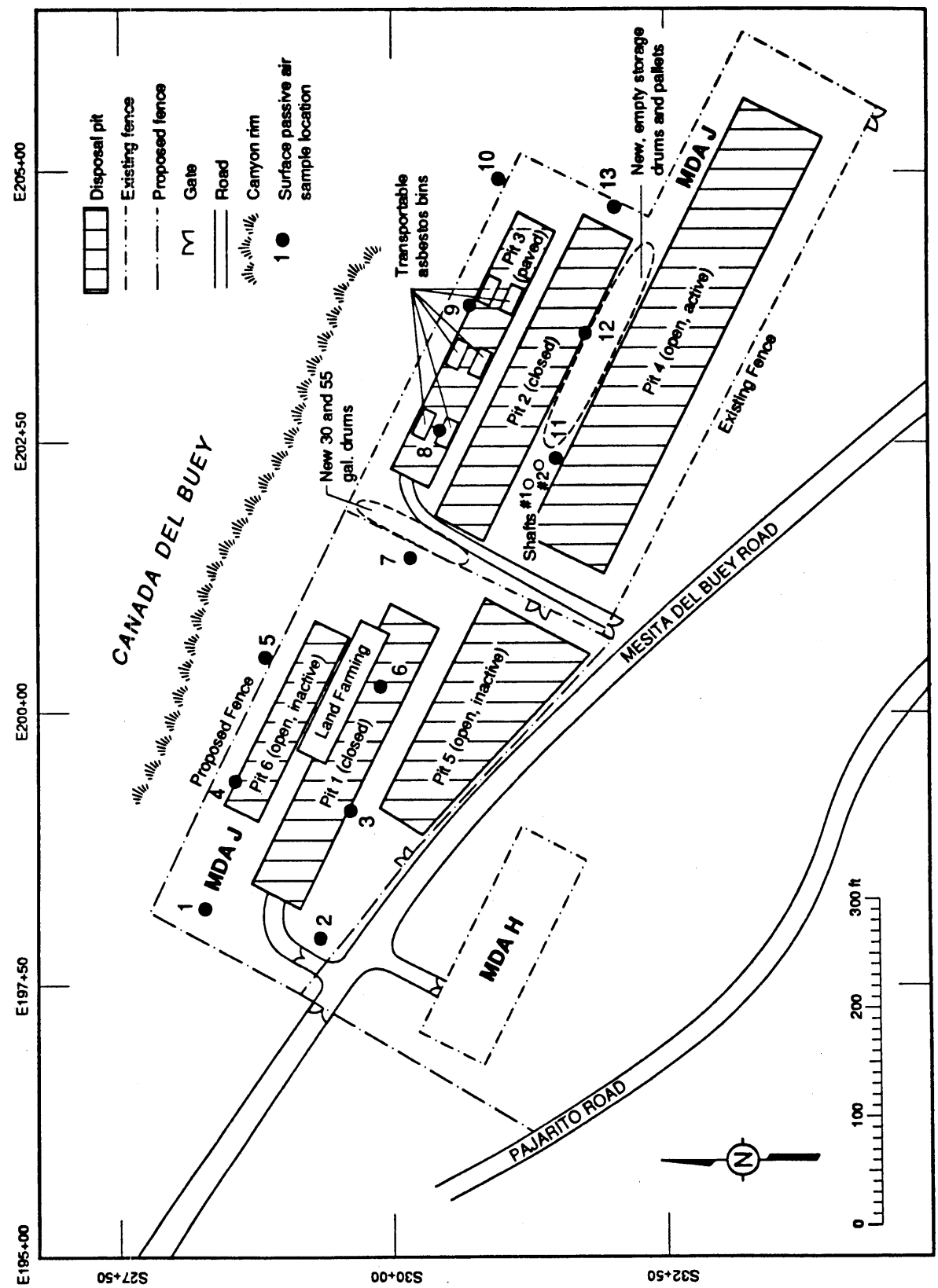

Figure 5.1-7 Passive air sampling locations at MDA J.

remain in place for three days. The cartridges will be analyzed for volatile organic compound concentrations.

Task 3. Data Reduction

All data will be validated according to the EPA functional guidelines for organic analysis (EPA 1988, 0293). This will provide the highest quality data for site characterization.

5.1.4.4.5 Sampling Activity

A total of 26 passive air samples will be collected at MDA J (13 samples x 2 sampling events = 26). The locations of each sampling point are shown on Figure 5.1-7. Table 5.1-15 lists the number of samples, the number of QC samples, and the analytical requirements for the Phase I investigation. It also describes the types of QC samples required.

EMFLUX® cartridges will be used to collect passive air samples in MDA J. The Quadrel Services Inc. laboratory, providing the precleaned cartridges, will supply certificates of cleanliness for the cartridges. All sample EMFLUX® cartridges will be left on site for a 72 hr period. If adsorption is allowed to continue for longer than 72 hrs, breakthrough may occur.

Sampling events will be based on the time of maximum vertical gas movement and will occur once during a cool season (March, April, or May), and once during the following warm months (June, July, or August). Periods of maximum vertical gas movement will be determined by Quadrel Services, Inc., at which time the samples will be collected.

The timing of collector deployment and the length of the survey sampling period are critical elements of the EMFLUX® system. For each project, and well in advance of anticipated field work, Quadrel will furnish the date and hour by which all collection devices must be in place, using for this determination the company's computerized earth-tide/gas-migration model.

5.1.4.4.6 Remaining SAP Elements

The remaining required elements of this SAP are common to all of the SAPs prepared for OU 1148. These common elements are listed in Table 5.1-8 and are located in Appendix B of this RFI work plan.

5.1.4.4.7 Phase II SAP

Data collected during the Phase I sampling effort will produce a "snapshot in time" to provide characterization of the potential VOC flux in MDA J. No Phase II SAP is proposed for passive air sampling at MDA J.

TABLE 5.1-15
PHASE I SAMPLING AND ANALYSIS PLAN TABLE FOR
PASSIVE AIR SAMPLING AT MDA J

Media	# of Samples	# of QC[a] Samples	Total Samples	Analysis
Soil gas	26	7	33	VOCs

[a] Includes: Trip Blank, Field Blank, and Duplicate Sample.

Trip Blank: An EMFLUX® cartridge that is taken to the field during a sampling event and then shipped back to the analytical contractor along with the field samples. The trip blank will remain unopened both from and to the laboratory.

Field Blank (Ambient or Control Point Sample): A sample taken to assess the ambient conditions at the sampling site. An EMFLUX® sampling device is set up on a control point barrier (three or four layers of aluminum foil) near a designated sampling point and the cartridge is exposed for the time period required for EMFLUX® sampling devices. One control point sample will be taken for every 10 samples.

Duplicate Sample: Collocated soil gas samples obtained by placing two sample cartridges adjacent to each other. Both cartridge will be exposed simultaneously and submitted to the analytical contractor through the SCF as consecutive samples.

5.1.4.4.8 Health and Safety

This SAP will follow the procedures outlined in the Laboratory's Environment, Safety and Health Manual (LANL 1990, 0335) and in Annex III of this RFI work plan.

5.1.4.4.9 Schedule

See Annex I.

5.1.4.5 Soil Sampling for Tritium at MDA J

Tritium (^3H, or T) is produced naturally in the upper atmosphere by cosmic irradiation, and as a fission or neutron activation product in nuclear reactors. Tritium can exist in the gas phase as HT or T_2; however, tritium oxidation and exchange reactions with H_2O produce tritiated water, HTO, which is the most common form of environmental tritium (NCRP 1979, 0739). Uptake of inhaled or ingested HTO is rapid and 99% efficient (NCRP 1979, 0739). Although inhalation exposure of people to HT gas might occur, uptake is inefficient and only 0.004% of the inhaled HT is absorbed after oxidation to HTO. Thus, it would require approximately 25,000 ppm of HT in air to pose the same hazard as 1 ppm HTO. Therefore, this SAP is directed toward detection of tritiated water vapor.

5.1.4.5.1 Sampling and Analysis Components

The purpose of collecting and analyzing surface soil samples for tritium at MDA J is to confirm the absence or presence of tritium contamination in shallow soils at MDA J. This SAP is designed to obtain technically accurate and legally defensible data on tritium concentrations that are necessary to support the DQO decisions. Phase I of this SAP will use a random sampling approach to confirm the absence or presence of tritium-contaminated soil.

5.1.4.5.2 Sampling and Analysis Approach

Because environmental tritium occurs as tritiated water, tritium sampling methods have been developed to isolate and analyze moisture which often occurs in vapor form (NCRP 1976, 0738). Tritiated water associated with soil samples is absorbed by a desiccant, isolated by distillation, and measured by liquid scintillation counting.

5.1.4.5.3 Primary Data Quality Factors

5.1.4.5.3.1 Prioritized Data Uses

The data to be collected are necessary for site characterization and risk assessment.

- Site Characterization - A limited sampling program for tritium is required to confirm the absence or presence of soil contamination.

- Risk Assessment - Source term data for tritium are needed to determine the potential surface emanation rate of tritium for unit risk calculations and to provide source term data for flow and transport modeling using TRACR3D.

5.1.4.5.3.2 Appropriate Analytical Levels

The sampling and analysis methods described in Section 5.0 of Appendix B correspond to Level V analytical methods and will be used throughout this SAP. Because these tritium measurements correspond to Level V, the Phase I sampling and analysis effort will be directed toward determining the locations of greatest contamination, and providing concentration and emanation data as needed to support risk assessments.

5.1.4.5.3.3 Primary Contaminant of Concern

Tritium in the form of tritiated water vapor in soil (HTO) is the contaminant of primary concern for this sampling activity at MDA J.

5.1.4.5.3.4 Levels of Concern

The DOE Derived Concentration Guide for tritium in uncontrolled areas is $1x10^{-7}$ µCi/ml in air (Environmental Surveillance Group 1990, 0497). DOE Order 5280.2A requires that the radiation exposure of the general public from waste disposal activities will not exceed 100 mrem/yr.

5.1.4.5.3.5 Required Quantitation Limits

The quantitation limit concentration for tritium in soils is 0.003 pCi/g (Environmental Surveillance Group 1990, 0497).

5.1.4.5.3.6 Critical Samples

Twenty-five percent of the samples collected (three of 13) are to be designated as critical samples.

5.1.4.5.4 Rationale for Sampling Activity

The rationale for this tritium sampling and analysis plan is to collect data to provide the surface emanation rates required to describe the source term for transport models and risk assessments.

5.1.4.5.5 Sampling Activity

Soil samples for tritium analysis will be collected according to the procedures in Section 5.0 of Appendix B. A minimum of 1 kg of soil will be collected for each sample. This mass represents the mass required to allow the quantitation limit concentration of 0.003 pCi/g. One set of 13 samples will be collected from the locations shown on Figure 5.1-8.

Table 5.1-16 lists the number of samples, the number of QC samples, and the analytical requirements for this Phase I investigation. It also describes the types of QC samples required.

No screening for tritium will be done in the field. Routine scanning in the field for alpha and beta/gamma emitters will be done as a preliminary indicator of radiological contamination. Field instruments, such as the "Violinist," which is available from HS-12, can be used to detect alpha emitters by detecting the related gamma emissions. This instrument is an upgrade of the "Fidler" instrument.

5.1.4.5.6 Remaining SAP Elements

The remaining required elements of this SAP are common to all of the SAPs prepared for OU 1148. These common elements are listed in Table 5.1-8 and are presented in Appendix B of this RFI work plan.

5.1.4.5.7 Phase II SAPs

If concentrations of tritium in soil exceed health risk-based criteria during the Phase I investigation, then vegetation samples will be collected for tritium analyses at MDA J. These samples will be collected from the three locations with the highest tritium concentrations during Phase I. Table 5.1-17 summarizes the Phase II sampling plan for MDA J.

5.1.4.5.8 Health and Safety

This SAP will follow the procedures outlined in the Laboratory's Environment, Safety and Health Manual (LANL 1990, 0335) and in Annex III of this RFI Work Plan.

5.1.4.5.9 Schedule

See Annex I.

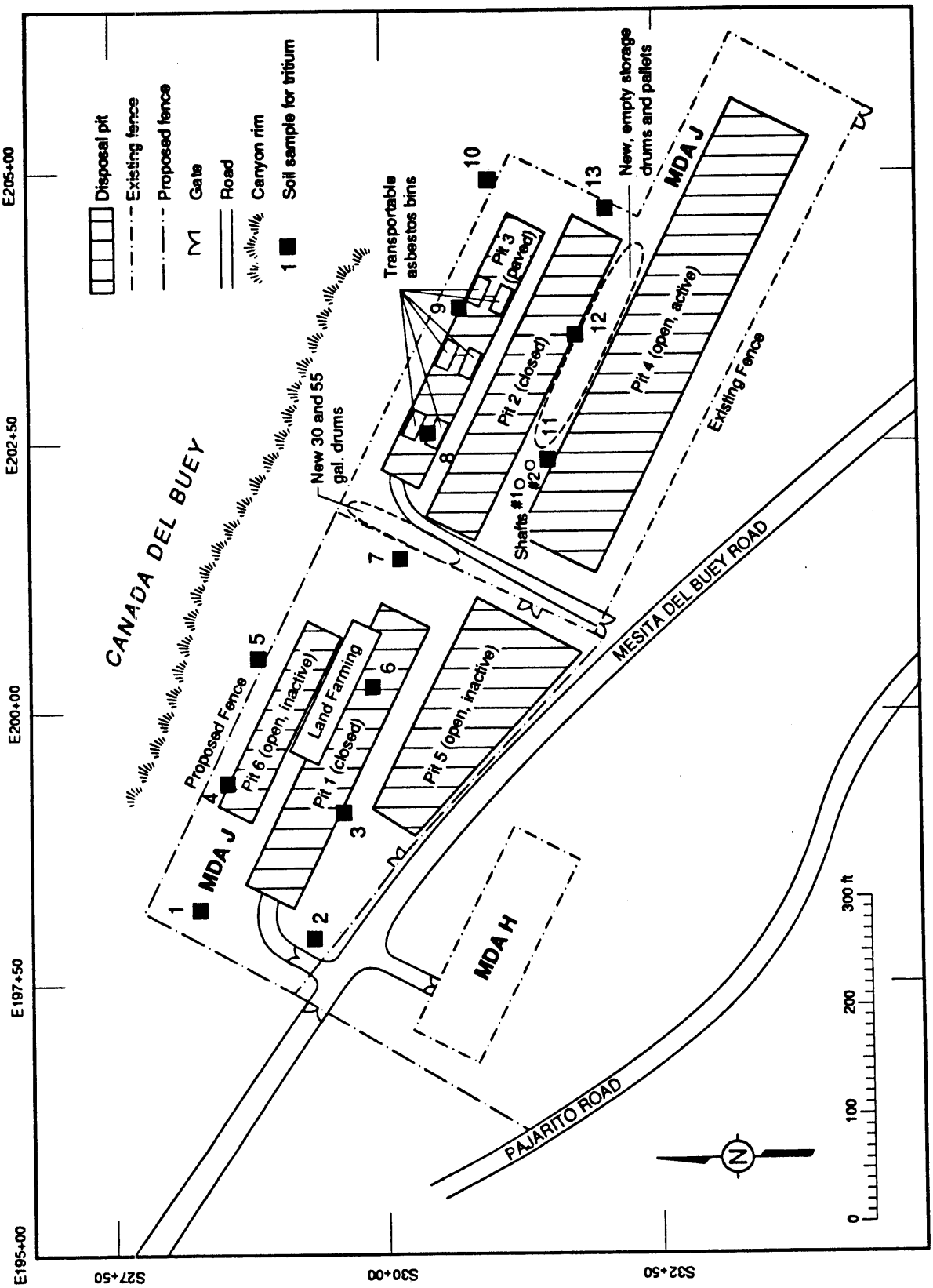

Figure 5.1-8 Tritium soil sampling locations at MDA J.

TABLE 5.1-16
PHASE I SAMPLING AND ANALYSIS PLAN TABLE FOR TRITIUM IN SOILS IN MDA J

Media	# of Samples	# of QC[a] Samples	Total Samples	Analysis
Soil	13	3	16	Tritium

[a] Includes Field Blanks, Duplicate Samples, and Equipment (Rinsate) Blanks.

Field Blanks: Organic-free water is poured into sample containers at the sampling site.

Duplicate Samples: Split a soil sample into two duplicate samples. Fill the sample containers simultaneously from the same sampling area.

Equipment (Rinsate) Blanks: Pour organic-free water over clean, decontaminated sampling equipment. Pour the water over the equipment surface that comes in contact with the sample. Collect the rinsate in a sample container and treat the equipment blank as a water sample.

TABLE 5.1-17
PHASE II TRITIUM SAMPLING AT MDA J

Media	Phase II Sampling	Rationale	Analysis	# of Samples
Vegetation	3 locations	Sample if tritium exceeded health risk-based criteria during Phase I.	COCs	3 + 3 QCs 6 Total

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5.2 Material Disposal Area H

MDA H contains nine shafts used for subsurface disposal of classified wastes. These shafts are collectively identified as SWMU 54-004 in the Solid Waste Management Units Report (LANL 1990, 0145).

5.2.1 Background

5.2.1.1 Description and History of SWMU

MDA H is a fenced, 0.3-acre, rectangular area measuring 200 ft by 70 ft, positioned just inside the western boundary of TA-54 on the south side of Mesita del Buey Road. It contains nine vertical shafts arranged along a line 15 ft inside its southern fence. The fence is 70 ft from the southern edge of the mesa and 170 ft from the edge of the mesa on the east side (see Figure 5.2-1).

The nine shafts were used for disposal of classified wastes from May 1960 to August 1986. Construction details and the period of use for each shaft are provided in Table 5.2-1.

While active and between uses, each shaft was covered with a steel plate that could be padlocked to prevent the possible theft of classified waste. The steel plate was connected to a steel sleeve that extended approximately 6 ft into the shaft from the surface. Such a cover assembly still exists over Shaft 9, which, as indicated in Table 5.2-1, has not yet been permanently sealed.

Wastes were dropped into the shafts, and packages and containers too heavy to manipulate by hand were lowered by crane. A guard rail constructed of steel fence posts about 4 ft high was moved from shaft to shaft to prevent workers from falling into the shafts when they disposed of waste materials. When the shafts were filled to capacity, within 6 ft of the surface, they were backfilled with crushed tuff to stabilize the waste materials, then capped with 3 ft of concrete and another 3 ft of soil. The earthen cap was then seeded. Because all of the potential release sites within MDA H are similar in design, received similar waste materials, and are in proximity to each other, they are being handled as a single SWMU Aggregate during this investigation. Thus, this geographic area consists of a single SWMU Aggregate, which in turn consists of a single SWMU, MDA H, comprised of nine individual potential release sites (LANL 1990, 0145).

Shaft 9 is the only potential release site in MDA H that intentionally received hazardous waste after 1980 (see Section 5.2.2.1), making it subject to RCRA interim status closure provisions and State of New Mexico jurisdiction (as indicated in Table 1.2-3 in Section 1.2.2 of this Work Plan). The original closure plan for Shaft 9 at MDA H was submitted in November 1986, and this RCRA Facility Investigation (RFI) Work Plan serves as the first in a series of planned modifications (see Section 1.2.2 of this Work Plan). The amount of waste disposed of in Shaft 9 is 990 ft^3, although the capacity of the shaft is about 1,700 ft^3. Of the 990 ft^3 of waste, only a small portion (15 lbs of LiH) is known to be a hazardous constituent.

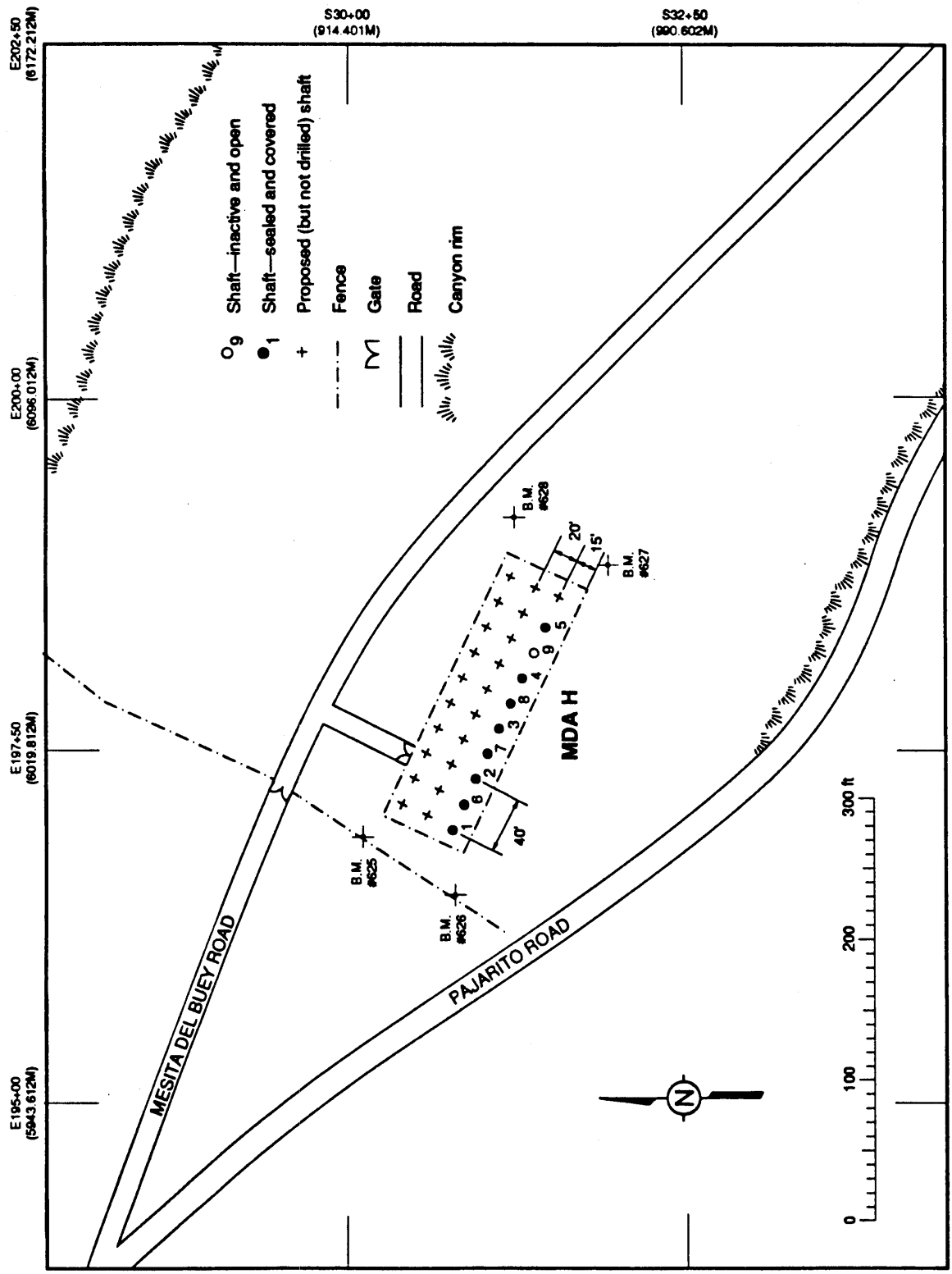


Figure 5.2-1 Location of shafts in MDA H at TA-54 (LANL 1974 [ENG-R4465]).

TABLE 5.2-1
CONSTRUCTION DETAILS AND PERIODS OF USE FOR SHAFTS AT MDA H

Shaft	Diameter	Depth	Period of Use	Date Capped
1	6 ft	60 ft	5/3/60 - 9/27/61	10/11/61
2	6 ft	60 ft	10/17/61 - 5/15/63	Unknown
3	6 ft	60 ft	6/4/63 - 11/19/64	12/10/64
4	6 ft	60 ft	12/23/64 - 8/16/66	9/66
5	6 ft	60 ft	10/7/66 - 9/27/67	Unknown
6	6 ft	60 ft	7/12/67 - 3/6/69	3/13/69
7	6 ft	60 ft	3/21/69 - 9/8/71	9/30/71
8	6 ft	60 ft	10/4/71 - 7/16/79	12/12/79
9	6 ft	60 ft	7/23/80 - 8/29/86	Not Capped

MDA H is within the boundaries of TA-54, which is intended to serve as an active waste-disposal area for the Laboratory for the foreseeable future. Because of this, an indefinite period of institutional (access) control will be assumed, so that any releases to the environment within MDA H will be cleaned to levels calculated in a manner consistent with the conditional remedy requirements of RCRA Subpart S. However, if a release of hazardous substances has migrated beyond the boundary of institutional control (outside the fenced area of MDA H), more conservative cleanup levels consistent with unrestricted land uses will be used, and source controls will be considered.

5.2.1.2 Conceptual Exposure Model

5.2.1.2.1 Existing Information on Nature and Extent of Contamination

MDA H was originally intended to receive solid, "clean" classified waste for permanent disposal in a secure manner. No liquids were ever disposed of in MDA H according to M. Salazar, formerly of H-7 (the old Waste Management Group), who witnessed disposal operations at MDA H during almost its entire operating life (Krueger 1991, 08-0036). In the context of the early 1960s, "clean" classified waste meant nonradioactive waste with classified characteristics. However, such waste materials may have been contaminated with materials that today could be considered hazardous. In a memorandum to W. T. Aldrich dated July 6, 1965, D. S. Clayton stated:

> Effective July 6, 1965, all waste materials that are both classified and radioactive will be disposed of in the SP-2 classified shaft disposal location, MDA H, Mesita del Buey. As you are aware, this area has, until now, been restricted to the disposal of clean classified material or classified material that is considered to be contaminated with trace amounts of high explosives. (Krueger 1991, 08-0036).

Clayton's statement indicates that shafts in use prior to July 6, 1965, received only nonradioactive materials; however, an examination of the tabulated waste-disposal log for MDA H (formerly classified), provided in Appendix II of the Operable Unit 1148 Data Report (IT Corporation 1992, 08-0015) and summarized below and in Table 5.2.2, refutes this notion. The waste-disposal log shows that nearly every shaft in MDA H received the following materials: weapon components; classified documents and paper; aluminum, plastic, stainless steel, rubber, and graphite classified shapes; weapon mock-ups (models); depleted uranium scraps and classified shapes; film, prints, and slides; classified objects contaminated with high explosives; and graphite nuclear reactor fuel elements. These materials comprise the bulk of the wastes disposed of in all nine shafts; however, each shaft received other waste materials that are highlighted in Table 5.2-2.

In addition to these materials, Shaft 9 reportedly received two containers containing a total of 15 lbs of lithium hydride in solid form. This waste load was placed approximately 5 ft from the bottom of the shaft on December 8, 1981, according to a memorandum from B. R. Myers to Distribution dated March 6, 1986. (Myers 1986,

TABLE 5.2-2
ADDITIONAL WASTES DISPOSED OF IN MDA H

Shaft	Waste Material
1	Tungsten carbide scrap Tungsten alloy scrap Phenolin classified shapes Atomic Energy Act (AEA) radioactive sources Copper spheres Detonators Solid radioactive waste (2 drums) Graphite Kiwi components
2	Air masks Kiwi modules Styrofoam classified shapes
3	Kiwi mockup Lithium fluoride PBX Beryllium classified shapes and scrap Titanium classified shapes
4	Kiwi slats Lithium classified shapes Hedgehog train units and detonators Tritium-contaminated units (4) Magnesium hemispheres (2) Lithium hydride classified shapes
5	Titanium classified shapes Plutonium-contaminated records Obsolete reactor parts and hardware Mandrils
6	Copper classified shapes Beryllium classified shapes Expended mortar shells
7	Firing units and detonators Copper spheres Beryllium classified shapes Lithium hydride classified shapes Plutonium-contaminated shapes Lead coil assemblies Klystrons Machine gun/barrels

TABLE 5.2-2, (Continued)
ADDITIONAL WASTES DISPOSED OF IN MDA H

Shaft	Waste Material
8	Detonator components Beryllium classified shapes and scrap Lithium samples Silos (16, from the Silo Program) Lithium boride Washing machine and hydraulic lift Shrapnel fragments
9	Graphite with motor oil (13 drums) Computer disks and tapes Mandrils Lithium Hydride

08-0037) Lithium hydride can react violently with water to form potentially explosive hydrogen gas. It is worthy of note that, except for a date, an entry confirming Myers' memorandum cannot be found in the MDA H logbook.

5.2.1.2.2 Potential Pathways of Contaminant Migration

Tritium apparently migrated from the shafts in the 1960s and early 1970s. A scientific team conducting a study to determine background values for tritium in tuff in November 1969 took subsurface samples during the drilling of Shaft 8. According to a memorandum from J. W. Aeby to W. R. Kennedy dated November 21, 1969, a soil-moisture sample taken at a depth of 40 ft inside Shaft 8 yielded an activity of about 4.6×10^6 disintegrations per minute per milliliter (dpm/ml) (2.0×10^9 pCi/L) (Aeby 1969, 0041).

Air samples taken in Shaft 8 at a depth of 40 ft yielded results half an order of magnitude lower than the soil-moisture results, averaging 9.7×10^5 dpm/ml (4.4×10^8 pCi/L) (see sample numbers 8, 9, and 10 in Table 5.2-3). An air sample was taken from Shaft 7 (40 ft east of Shaft 8), which was still in use at the time. This sample yielded a result of 3.5×10^5 dpm/ml (1.6×10^8 pCi/L). The DOE Derived Concentration Guide (DCG) for tritium in air is 1.0×10^{-7} µCi/ml (i.e., 1.0×10^2 pCi/L).

Because of these unexpected results, Aeby and his team launched a limited investigation to determine the extent of contamination. Their soil and air sampling locations are shown on Figure 5.2-2, and the results are provided in Table 5.2-3.

In 1973, another sampling exercise was initiated to assess the extent of tritium contamination in the four years since the release was first detected. Samples were taken in the surface soil along a line perpendicular to the southern fence, and from flora in the area. The results of this sampling are given in Table 5.2-4.

The tritium data collected in 1969 and 1973 indicate that tritium releases have occurred to the subsurface, where it may be migrating via vapor phase transport to form a contaminant plume. The tritium content of the flora in MDA H indicates that tritium is reaching the surface or near-surface where it can be released to the atmosphere through evapotranspiration. Therefore, transport beyond the area of institutional control at MDA H via the air migration pathway is a potential exposure route.

Accidents or spills are not known to have occurred at MDA H; however, it is possible that contaminants were released to the surface during disposal activities at the site. Contaminants in the surface soils at MDA H could be transported beyond the area of institutional control by surface water runoff and sediment transport mechanisms. These transport mechanisms also provide a migration pathway for tritium which has been transported to surface soils by vapor-phase transport from subsurface releases. Transport of contaminated dust via air migration pathway is also possible if surface soil contamination is present. The conceptual model for migration and exposure pathways for contaminants released from MDA H is shown on Figure 5.2-3.

TABLE 5.2-3
1969 TRITIUM SAMPLING RESULTS FOR MDA H

Sample #	Counts*	Activity (11/69)
1 (Soil)	4.6×10^{6}	2.1×10^{9} pCi/L
4 (Soil)	9.9×10^{3}	4.5×10^{6} pCi/L
8 (Air)	9.3×10^{5}	4.2×10^{8} pCi/L
9 (Air)	1.0×10^{6}	4.6×10^{8} pCi/L
10 (Air)	9.8×10^{5}	4.5×10^{5} pCi/L
11 (Air)	3.5×10^{5}	1.6×10^{8} pCi/L
12 (Soil)	2.0×10^{3}	9.1×10^{5} pCi/L
13 (Soil)	5.1×10^{1}	2.3×10^{4} pCi/L
18 (Soil)	1.4×10^{2}	6.6×10^{4} pCi/L
19 (Soil)	1.4×10^{2}	6.5×10^{4} pCi/L
20 (Soil)	5.3×10^{2}	2.4×10^{5} pCi/L
21 (Soil)	2.5×10^{2}	1.1×10^{5} pCi/L
22 (Soil)	2.5×10^{3}	1.1×10^{6} pCi/L
23 (Soil)	7.3×10^{1}	3.3×10^{4} pCi/L
24 (Soil)	2.8×10^{2}	1.3×10^{5} pCi/L
25 (Soil)	6.8×10^{3}	3.1×10^{6} pCi/L
26 (Soil)	3.8×10^{2}	1.7×10^{5} pCi/L
27 (Soil)	1.3×10^{2}	6.0×10^{4} pCi/L

*Counts were taken in 1969 and are in units of disintegrations per minute per milliliter.

Reference: Krueger 1991, 0042.

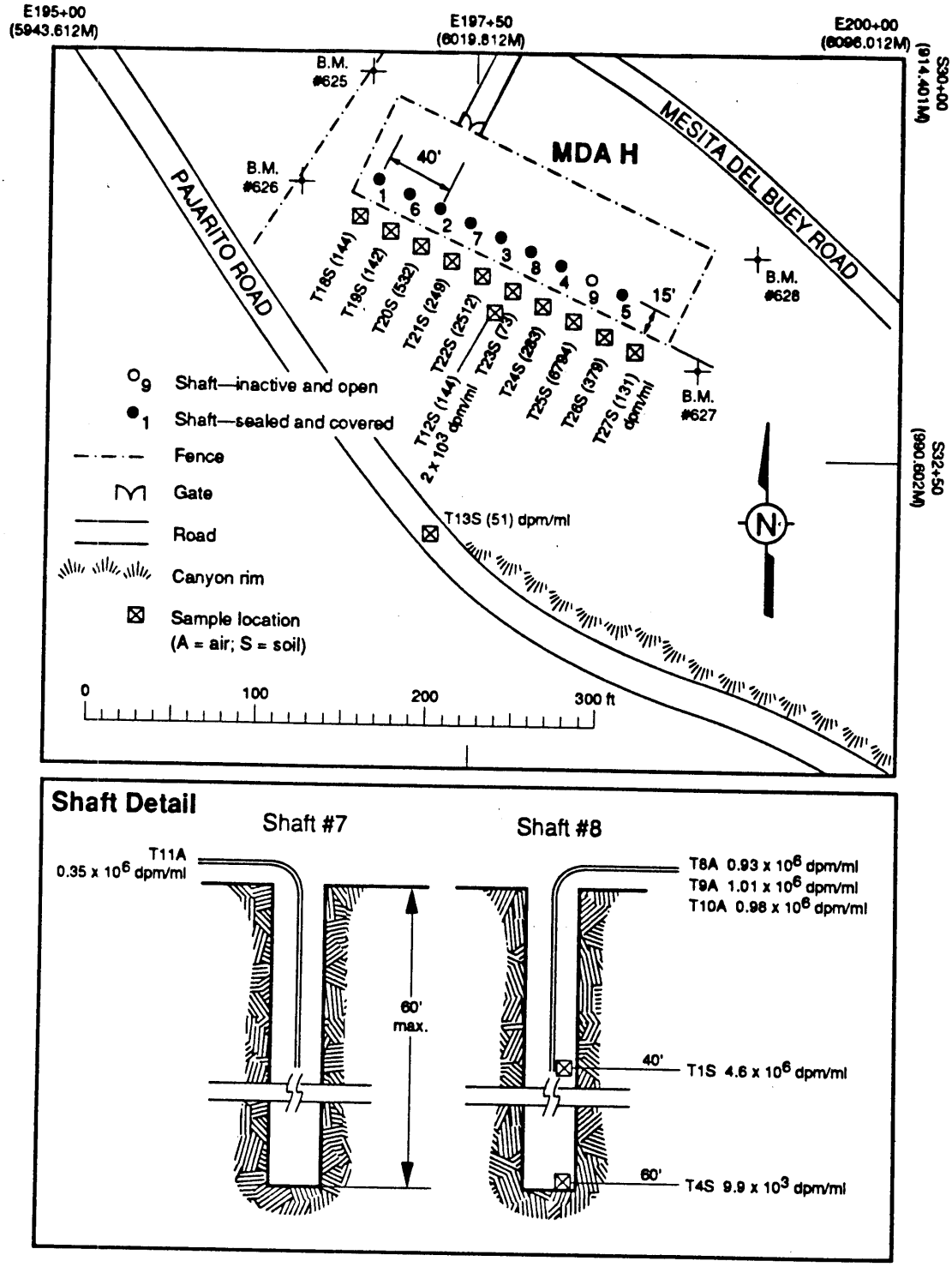


Figure 5.2-2 Soil and air sampling locations for MDA H at TA-54 in 1969 study. (Base map: LANL 1974 [ENG-R4465]).

TABLE 5.2-4
1973 SOIL AND FLORA SAMPLING RESULTS FOR MDA H*

Sample	Activity (9/73)
Soil at fence	7.79×10^4 pCi/L
Soil 20 ft south of fence	7.38×10^4 pCi/L
Soil 75 ft south of fence	3.08×10^4 pCi/L
Soil 150 ft south of fence	3.40×10^3 pCi/L
Background soil	2.40×10^4 pCi/L
Mountain Daisy near Shaft 8	3.41×10^6 pCi/L
Weed near Shaft 8	2.79×10^6 pCi/L
Piñon 60 ft east of SW corner of fence	6.10×10^3 pCi/L
Cedar 60 ft east of SW corner of fence	2.18×10^6 pCi/L
Cedar 65 ft west of SE corner of fence	1.40×10^6 pCi/L
Piñon background	2.40×10^3 pCi/L
Cedar background	2.30×10^3 pCi/L
Background weeds	2.00×10^3 pCi/L
Background Mountain Daisy	2.1×10^3 pCi/L

* Krueger 1991, 0042.

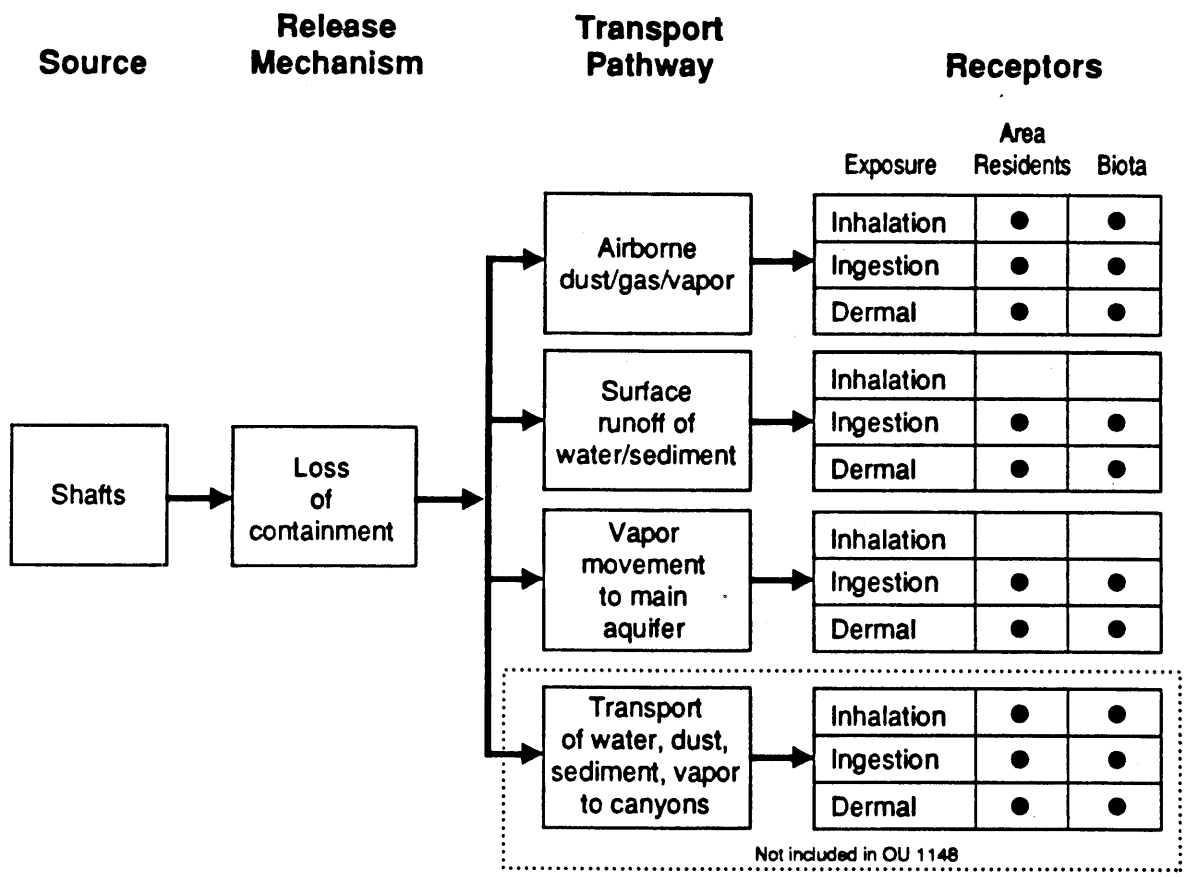


Figure 5.2-3 Conceptual model for MDA H.

5.2.1.2.3 Potential Public Health and Environmental Impacts

Tritium is a known contaminant which has been released from the disposal shafts at MDA H and could have potential public health and environmental impacts. Exposure to the general population at the closest residential areas (Los Alamos and White Rock) is not a concern due to distances and dispersion effects. However, potential exposures to workers in the area surrounding MDA H and to Laboratory employees that jog along Mesita Del Buey Road during lunch breaks and after work is unknown.

Previous sampling has shown that flora at MDA H have elevated tritium concentrations. There is a potential exposure to tritium to small herbivores which may feed on the contaminated flora in MDA H.

Potential public health and environmental impacts from exposures to tritium and other potential contaminants in surface soils is expected to be negligible due to dispersion in the transport of dust by the air pathway, the surface water runoff pathway, and the sediment transport pathway. Direct exposure to surface soils at MDA H is not considered an exposure pathway because the MDA is under institutional control.

Impacts to ground water are considered negligible due to dispersion along the pathways through which contaminants might reach ground water. These transport pathways include vapor phase transport through approximately 1,000 ft of vadose zone to the main aquifer, or transport via surface water runoff from the mesa top to the canyon followed by infiltration into an alluvial aquifer.

5.2.2 Remediation Alternatives and Evaluation Criteria

The preliminary response action at MDA H, based on tritium being the primary contaminant of concern, is to maintain institutional control of the MDA and to monitor the control boundaries for tritium migration. Air, surface water runoff, and sediment samples will be collected to monitor the migration of tritium beyond the area of institutional control.

5.2.3 Data Needs and Data Quality Objectives

5.2.3.1 Health and Safety Risks

5.2.3.1.1 Source Characterization

Some of the potential contaminants disposed of in the shafts at MDA H (e.g., radioactive wastes, traces of high explosives, and lithium hydride) are known. However, incomplete records and the classified nature of the materials disposed prevents a full characterization of all potential contaminants disposed of in the shafts

and an estimation of potential contaminant volumes. There have been releases of tritium at MDA H, but it is not possible to characterize potential public health or environmental hazards or to assess likely remedial options based on existing information. An accurate understanding of the type of wastes disposed of in the MDA H disposal shafts is not available without actually sampling the materials in the shafts. The data needs presented in Table 5.2-5 will provide a better understanding of the nature of the source.

5.2.3.1.2 Environmental Setting

The potential migration pathways for contaminants released from the disposal shafts at MDA H have been identified conceptually, but the actual types and quantities of contaminants leaving the MDA are unknown. The most important data needs pertaining to contaminant migration pathways at MDA H include:

- an estimation of the amount of tritium leaving the institutionally controlled area via the air pathway;
- a characterization of contaminants leaving the institutionally controlled area via the surface water runoff and sediment transport pathways; and
- a characterization of contaminants present in the subsurface.

The specific data needed for MDA H Phase I sampling plans are given in Table 5.2-6.

5.2.3.1.3 Potential Receptors

Many of the scenarios for exposure to contaminants from MDA H are not cause for concern of public health or environmental impacts due to dispersion in the migration pathways. However, there are two potential public health and environmental impacts which need to be addressed:

- the potential impact to Laboratory employees and Laboratory visitors who travel the road adjacent to MDA H from tritium released to the air; and
- the potential impact of herbivores that may eat tritium-contaminated flora.

Table 5.2-7 lists the data needed for receptor characterization. The data needed to identify and characterize the potential receptors is based on inputs into models for determining risk. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 version of the Installation Work Plan (IWP). This approach will be developed in adequate time for data analysis.

TABLE 5.2-5
INFORMATION NEEDED FOR PHASE I SOURCE CHARACTERIZATION OF MDA H SUBSURFACE DISPOSAL UNITS[a]

1. Constituent Concentrations in Media

   SW-846 Volatile Organic Compounds (VOCs)
   SW-846 Semivolatile Organic Compounds (SVOCs)
   SW-846 Metals
   Pesticides
   PCBs
   Reactive Cyanide
   Tritium
   Gross alpha, gross beta, and gamma emitters

2. Media

   Surface Water
   Soils/sediments
   Air

[a]These constituents and associated analytical methods are given in the Laboratory's IWP (LANL 1991, 0553).

TABLE 5.2-6
INFORMATION NEEDED FOR PHASE I TRANSPORT PATHWAY CHARACTERIZATION OF MDA H SUBSURFACE DISPOSAL UNITS

1. Surface Water Runoff Pathway

   Monthly Rainfall Averages
   Drainage Patterns
   Background Concentration of Each Constituent

2. Soils/Sediments Pathway

   Respirable Dust Fraction
   Erodability
   Organic Carbon Content
   Moisture Content
   Background Concentration of Each Constituent

3. Air Pathway

   Wind Roses
   Wind Erosion Data
   Background Concentration of Each Constituent

4. Subsurface Migration Pathway

   Rock Mineralogy
   In Situ Air Permeability of Characteristic Rock Types
   Fracture Density
   Hydraulic Conductivity
   Background Concentration of Each Constituent

TABLE 5.2-7
INFORMATION NEEDED FOR PHASE I POTENTIAL RECEPTOR CHARACTERIZATION ACCORDING TO MDA H CONCEPTUAL MODEL

1. General Land Use
   Present uses and possible future uses of surface features draining MDA H:
   a. Closure with continued institutional control.

2. Human
   Human use of or access to MDA H and adjacent lands, including:
   a. Relationship between population centers and prevailing wind direction;
   b. Native American access to archeological sites under institutional control.
   c. Recreational use to adjacent land under management by Bandelier National Monument.

3. Demography
   A demographic profile of the people who use or have access to MDA H and adjacent land, including, but not limited to: age; sex; and sensitive subgroups. These receptor groups will be investigated if Phase II sampling is undertaken.

4. Biota
   A description of the biota on, adjacent to, or affected by MDA H. These receptor groups will be provided if Phase II sampling is undertaken.

5. Ecology
   A description of the ecology overlying and adjacent to MDA H will be provided if Phase II sampling is undertaken.

6. Endangered/Threatened Species
   A description of any endangered or threatened species near MDA H.

7. Risk Assessment
   The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 version of the Installation Work Plan. This approach will be developed in adequate time for data analysis.

5.2.3.2 MDA H Data Quality Objectives

The decision processes and data quality objectives (DQOs) described in this section are specific to MDA H SWMUs. The subsection format follows the more general process described in detail in Section 1.4. The reader is referred to Section 1.4 for definitions of terms and decision criteria, and to Figure 1.4-1 for the decision flow chart.

5.2.3.2.1 MDA H Decision Process

Decision Point 1:

On the basis of existing information, is there any potential risk to human health or the environment from the subsurface disposal units at MDA H?

Yes. Tritium and Pu-contaminated waste have been reported in laboratory disposal records, and a release of tritium to the environment has also been reported.

Decision Point 2:

Is existing information sufficient to allow development of a Phase II sampling plan?

No. Existing laboratory disposal records identify tritium and other radioactive wastes, traces of high explosives, and lithium hydride. Therefore, a Phase I Sampling and Analysis Plan (SAP) will be executed at MDA H. As quantitative data become available, Phase I SAPs will be revised as appropriate. Data acquired in the Phase I investigation will serve as input to the next decision (Figure 1.4-1).

Decision Point 3:

Do the data collected in Phase I sampling confirm the presence of COCs at MDA H?

This question is addressed by the DQO process for MDA H. The DQOs for Phase I SAPs follow the format of Section 1.4.3.1, and the diagram shown on Figure 1.4-2.

Problem Statement

Constituents of concern are known to be present in subsurface disposal units, but data on concentrations and specific locations are not sufficient to allow design for an effective Phase II sampling plan.

Questions To Be Answered

Are the concentrations of constituents of concern in air, water, soils, sediments, or the subsurface above background levels or above health risk-based action levels?

Decision Inputs/Data Needs for MDA H

Constituents of concern (COCs) for MDA H are summarized in Table 5.2-5. Volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and metals are specified in the Generic QAPjP (LANL 1991, 0412), and action levels for many of the constituents are available in Proposed RCRA Subpart S.

No suite of radionuclides of concern (ROCs) is specified in Proposed RCRA Subpart S. Existing information on the MDA H waste inventory was reviewed, and tritium was the only radionuclide identified that has the capacity to be mobile. However, some classified waste that may contain other radionuclides was deposited at MDA H. Thus, the Phase I sampling plans include measurements of gross alpha and gross beta radioactivity, as well as gamma spectroscopy of samples.

The Phase I SAPs were developed to determine the COC concentration in each environmental transport medium in the conceptual model (Figure 5.2-3). The COCs in each transport medium of the Phase I SAPs are summarized in Table 5.2-8.

Decision Domain

The spatial domain includes all of TA-54, MDA H, and excludes the adjacent canyons, which are addressed in OU 1049. The Laboratory will maintain institutional control at MDA H as discussed in Section 1.0.

Decision Rule/Logic Statement

The decision made at Decision Point 3 will be based on the following rule: If the maximum concentration of any COC in any sample does not exceed action levels or the natural background concentration, MDA H will be recommended for no further action.

This outcome of the Phase I plan is unlikely at MDA H. Because historic releases have occurred, and some COCs have been reported (Section 5.2.1.2), the Phase I plans discussed below have been designed to not only confirm the absence or presence of suspected COCs, but to provide initial data for transport models and for future health-risk assessments. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 version of the IWP. This approach will be developed in adequate time for data analysis. The results of the Phase I SAPs for MDA H will be used to validate transport models, to provide initial health-risk estimates, and to determine the requirements for Phase II SAPs.

Acceptable Uncertainty Limits

Because MDA H site and waste characterization data are lacking, it is not possible to determine true risk ranges and tolerance limits. The characterization data needed to develop Phase II SAPs and perform health-risk assessments will be determined using the results of Phase I sampling and the risk assessment approach to be outlined in the 1992 IWP.

TABLE 5.2-8
CONSTITUENTS OF CONCERN ADDRESSED
IN ENVIRONMENTAL TRANSPORT MEDIA AT MDA H

Transport Media	Constituents of Concern[a]	Phase I SAP (Section Number)
Surface Water	SW-846[b] VOCs[c], SVOCs[d], metals, pesticides, PCBs[e], cyanide, ^{3}H, gross alpha, beta, gamma radioactivity	5.2.4.1
Surface Sediments	see above	5.2.4.2
Underground Soils (Cores)	see above	5.2.4.3
Air	^{3}H	5.2.4.4

[a] Specific compounds are listed in the indicated SAP
[b] EPA 1983, 0288 for water; EPA 1987, 0518 for sediment and soil
[c] Volatile Organic Compounds
[d] Semivolatile Organic Compounds
[e] Polychlorinated biphenyls

5.2.3.2.2 Approach to DQO Process

The Phase I sampling plan will rely on four levels of analytical data to allow determination of precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters. The results of this determination will guide the development of the Phase II sampling plans, if they are needed. The four levels of analytical data to be used during Phase I sampling activities are

- Level I field screening to guide the selection of sampling locations for laboratory analyses;
- Level II field analysis to confirm Level I field screening results;
- Level III laboratory analyses with SW-846 protocols for VOCs, SVOCs, metals, pesticides, PCBs, and cyanide; and
- Level V laboratory analyses at a laboratory with approved SOPs for gamma spectroscopy, tritium, and gross alpha and gross beta analysis.

The pathways of concern at MDA H include surface water runoff, surface sediment transport, atmospheric dispersion, and subsurface migration of contaminants. It is important to characterize these pathways to determine if COCs are absent or present. If COCs are present and are found to be migrating beyond the boundaries of institutional control, a health risk-based assessment will be performed to develop potential response actions to meet the requirements of conditional remedy under RCRA Subpart S.

The health risk-based assessment will rely heavily on the data acquired during the Phase I and Phase II sampling and analysis activities at MDA H. The use of Level III and Level V data, described above, provides the required degree of accuracy, precision, and defensibility of data that are needed to assess risk to human health and the environment.

5.2.3.2.3 Phase I Field Investigation

Phase I data collection at MDA H is intended to accomplish the following:

- determine the presence or absence of COCs in the surface water runoff or sediment transport pathway from the MDA;
- determine through sampling if tritium migration from the MDA via air, surface water runoff, or sediment transport migration pathways is likely to have adverse impacts on the public health or the environment; and
- determine the presence or absence of a subsurface tritium plume and other contaminant plumes, by sampling boreholes.

5.2.3.2.4 Phase II Field Investigation

A Phase II sampling plan will be implemented, if required, following evaluation of the results of Phase I sampling and analysis. The Phase II sampling plan will be implemented to further characterize the nature and extent of contamination so that appropriate response actions can be developed.

5.2.4 Sampling Plans

5.2.4.1 MDA H Surface Water Runoff Sampling

5.2.4.1.1 Sampling and Analysis Components

The purpose of collecting and analyzing surface water runoff samples from MDA H is to accumulate technically accurate and legally defensible data to be used in site characterization and risk assessment. The data will be used to determine the potential for off-site migration of radionuclides or hazardous waste constituents in the waterborne pathway. The data will be validated according to the EPA functional guidelines for organic analysis (EPA 1988, 0293) and inorganic analysis (EPA 1988, 0296). Validation is necessary so that the quality of the data will be such that they can be used in risk assessment calculations. Currently, there are no published EPA methods for validating all radionuclide analyses.

5.2.4.1.2 Sampling and Analysis Approach

This SAP is designed to obtain information on contaminant concentrations and contaminant transport in the environment around MDA H that will support DQO decisions. One of the primary transport mechanisms from MDA H is surface water runoff during heavy storms; therefore, sampling will take place in the primary runoff pathway at MDA H.

5.2.4.1.3 Primary Data Quality Factors

5.2.4.1.3.1 Prioritized Data Uses

The data to be collected are necessary for site characterization and risk assessment.

- Site Characterization - The existing data for MDA H have not been validated and do not include all of the regulated VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, gross alpha, gross beta, or gamma emitters. Data will be collected to fill existing data gaps and to support the validity of the existing data.

- Risk Assessment - The data collected to determine the nature and extent of contaminants at MDA H will be used as input to a health risk-based assessment.

5.2.4.1.3.2 Appropriate Analytical Levels

Samples collected will be screened in the field and analyzed in a laboratory using EPA SW-846 (third edition) protocols. Photoionization Detectors (PIDs) and Flame Ionization Detectors (FIDs) will be used in the field to screen for organic vapors; alpha, beta, and gamma survey instruments will be used for field screening ionizing radiation. Below are the levels of analysis:

Level I Field Screen: PID/FID screen instruments; alpha, beta, gamma survey instruments,

Level II Field Analysis: Gas Chromatography (GC) with either a PID, FID, or Electron Capture Detector (ECD),

Level III SW-846 laboratory analysis for VOCs, SVOCs, metals, pesticides, polychlorinated biphenyls (PCB), and cyanide, and

Level V Radionuclide laboratory analysis at a laboratory with approved SOPs for gross alpha, gross beta, gamma spectroscopy, and tritium.

5.2.4.1.3.3 Primary Contaminants of Concern

The contaminants of concern at MDA H are VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, gross alpha, gross beta, and gamma emitters.

5.2.4.1.3.4 Levels of Concern

Appendix F of the IWP (LANL 1991, 0553) and 40 CFR 264, Proposed Subpart S, contain information on constituent levels of concern. Health risk-based determinations of levels of concern will be developed for constituents not listed in Appendix F. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 IWP. This approach will be developed in adequate time for data analysis.

5.2.4.1.3.5 Required Quantitation Limits

Quantitation limits for laboratory analysis of hazardous and radioactive constituents in water are given in Tables V.3 through V.9 of the Laboratory's Generic QAPjP (LANL 1991, 0412). Analytical methods used for surface water runoff samples at MDA H will fall in the range of these detection quantitation limits. The quantitation limits will be the current SW-846 protocol for VOCs, SVOCs, metals, pesticides,

PCBs, and cyanide. Level V analysis for tritium, gross alpha, gross beta, and gamma emitters will use the current Laboratory-approved analytical contractor or EM-9.

5.2.4.1.3.6 Critical Samples

The surface water runoff sample is a critical sample that will be collected during a heavy rainfall event.

5.2.4.1.4 Rationale for Sampling Activity

The rationale for surface water runoff sampling from the drainage area is to:

- determine if VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, gross alpha, gross beta and gamma emitters are being discharged from MDA H;
- further define source terms;
- collect data that can be used to support and supplement existing data for the DQO process; and
- collect data that can be used in a risk assessment.

5.2.4.1.5 Sampling Activity

One surface water runoff sample will be collected from the primary discharge point during Phase I sampling. The sampling location is shown on Figure 5.2-4. Table 5.2-9 summarizes the number of samples, the number of QC samples, and the analytical requirements for Phase I sampling. It also describes the types of required QC samples. Surface water runoff sampling procedures are presented in Section 1.0 of Appendix B.

5.2.4.1.6 Remaining SAP Elements

The remaining required elements of this SAP are common to all of the SAPs prepared for OU 1148. These common elements are listed in Table 5.2-10 and are located in Appendix B of this RFI Work Plan.

5.2.4.1.7 Phase II SAP

If the results of Phase I surface water runoff sampling indicate that COCs exceed health risk-based criteria, then Phase II surface soil sampling will be conducted at MDA H. Surface soil samples will be collected in 9 grid nodes of an MRI grid and analyzed for the COCs that exceeded the health risk-based criteria in the surface

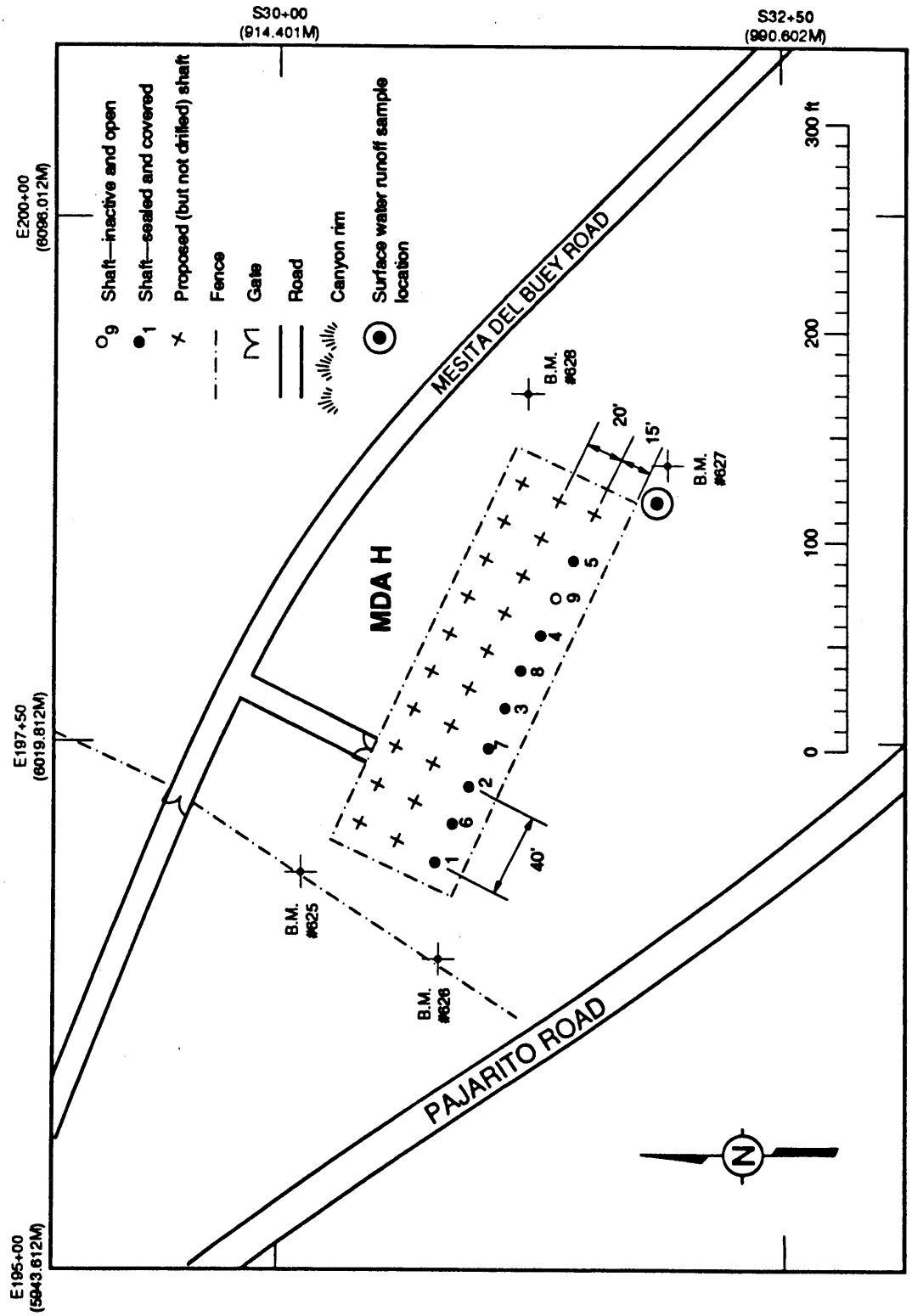


Figure 5.2-4 Surface water runoff sampling location at MDA H.

TABLE 5.2-9
PHASE I SAMPLING AND ANALYSIS PLAN TABLE FOR SURFACE WATER RUNOFF SAMPLING AT MDA H

Media	# of Samples	# of QC[a] Samples	Total Samples	Analysis
Water	1	4	5	VOCs SVOCs Metals Pesticides PCBs Cyanide Tritium Gross Alpha Gross Beta Gamma Spectroscopy

[a]Includes Trip Blank, Field Blank, Duplicate Sample, and Equipment (Rinsate) Blank.

Trip Blank: Two 40 ml VOC sample containers filled with organic-free water at the Sample Coordination Facility. Filled trip blanks accompany sample bottles to the field, remain unopened throughout the sampling activity, and return with shipment to the analytical laboratory. Submitted only when sampling for VOCs.

Field Blank: Organic-free water is poured into sample containers at the sampling site.

Duplicate Sample: Collect two separate surface water runoff samples simultaneously.

Equipment (Rinsate) Blank: Obtained by running organic-free water over cleaned, decontaminated sampling equipment. Rinse the equipment surface that comes into contact with a sample.

TABLE 5.2-10
FIELD SAMPLING PLAN ELEMENTS LOCATED IN APPENDIX B

1. Sample Collection Procedures
2. Field Documentation
3. Sample Preservation and Handling Procedures
4. Field Quality Assurance
5. Variance Situation
6. Equipment List
7. Equipment Calibration
8. Decontamination Procedures
9. Precision, Accuracy, Representativeness, Completeness, and Comparability Review

TABLE 5.2-11
PHASE II SURFACE WATER RUNOFF (SURFACE SOIL) SAMPLING AT MDA H

Media	Phase II Sampling	Rationale	Analysis	# of Samples
Soil	9 locations based on MRI grid	Sample if COCs exceed health risk-based criteria during Phase I sampling.	COCs	9 + 4 QCs 13 Total

water runoff sample. Table 5.2-11 summarizes the Phase II sampling and analytical requirements.

5.2.4.1.8 Health and Safety

This SAP will follow the procedures outlined in the Laboratory's Environment, Safety and Health Manual (LANL 1990, 0335) and Annex III of this RFI Work Plan.

5.2.4.1.9 Schedule

See Annex I.

5.2.4.2 MDA H Surface Sediment Sampling

5.2.4.2.1 Sampling and Analysis Components

The purpose of collecting and analyzing surface sediment samples in the drainage channel at MDA H is to determine the potential for off-site migration of radionuclides or hazardous waste constituents due to sediment transport in the surface water runoff pathway. The data will be validated according to EPA functional guidelines for organic analysis (EPA 1988, 0293) and inorganic analysis (EPA 1988, 0296). Validation is necessary so that the data will be of such quality that they can be used in risk assessment calculations. Currently, there are no published EPA methods for validating all radionuclide analyses.

5.2.4.2.2 Sampling and Analysis Approach

This SAP is designed to obtain information on contaminant concentrations and contaminant transport in the environment around MDA H that will support DQO decisions. One of the primary sediment transport mechanisms from TA-54 is surface water runoff during heavy rainstorms; therefore, surface sediment sampling will take place in the primary runoff area at MDA H.

5.2.4.2.3 Primary Data Quality Factors

5.2.4.2.3.1 Prioritized Data Uses

The data to be collected are necessary for site characterization and risk assessment.

- Site Characterization - The existing data for MDA H have not been validated and do not include all of the regulated VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, and gross alpha, gross beta, and gamma emitters.

Data will be collected to fill existing data gaps and to support the validity of the existing data.

- Risk Assessment - Data collected to determine the nature and extent of the contaminants at MDA H will be used as input to a health risk-based assessment.

5.2.4.2.3.2 Appropriate Analytical Levels

Samples collected will be screened in the field and analyzed in a laboratory using EPA SW-846 (third edition) protocols. PIDs and FIDs will be used in the field to screen for organic vapors; and alpha, beta, and gamma survey instruments will be used for field screening ionizing radiation. The levels of analysis follow:

Level I	Field Screen: PID/FID screen instruments; alpha, beta, gamma survey instruments,
Level II	Field Analysis: GC with either a PID, FID, or ECD,
Level III	SW-846 Laboratory Methods, and
Level V	Radionuclide Analysis Laboratory Methods.

5.2.4.2.3.3 Primary Contaminants of Concern

The contaminants of concern due to sediment transport in the surface water runoff pathway from MDA H are VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, and gross alpha, gross beta, and gamma emitters.

5.2.4.2.3.4 Levels of Concern

Appendix F of the IWP (LANL 1991, 0553) and 40 CFR 264, Proposed Subpart S, contain information on constituent levels of concern. Health risk-based determinations of levels of concern will be developed for constituents not listed in Appendix F. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 IWP. This approach will be developed in adequate time for data analysis.

5.2.4.2.3.5 Required Quantitation Limits

Quantitation limits for laboratory analysis of soil are given in Tables V.3 through V.9 of the Laboratory's Generic QAPjP (LANL 1991, 0412). Analytical methods used for surface sediment samples at MDA H will fall in the range of these quantitation limits. The quantitation limits will be the current SW-846 protocol for VOCs, SVOCs, metals, pesticides, PCBs, and cyanide. Level V analysis for tritium, gross alpha, gross beta, and gamma emitters will use the current Laboratory-approved analytical contractor or EM-9.

5.2.4.2.3.6 Critical Samples

Samples collected in the drainage channel at MDA H are critical samples because they represent potential transport beyond institutional control.

5.2.4.2.4 Rationale for Sampling Activity

The rationale for surface sediment sampling from the drainage area is to:

- determine if VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, and gross alpha, gross beta, and gamma emitters are being discharged from MDA H;
- further define source terms;
- collect data that can be used to support and supplement existing data for the DQO process; and
- collect data that can be used in a risk assessment.

5.2.4.2.5 Sampling Activity

One set of nine surface sediment samples will be collected from the primary runoff area during Phase I sampling. Figure 5.2-5 shows the location of the drainage basin to be sampled. The drainage basin has been divided into a 3- by 20-ft grid, and nine sample locations were randomly selected. The sample grid and the randomly selected sample points are also shown on Figure 5.2-5.

Table 5.2-12 summarizes the number of grab samples, the number of QC samples, and the analytical requirements for Phase I sampling. Surface sediment sampling procedures are presented in Section 2.0 of Appendix B.

5.2.4.2.6 Remaining SAP Elements

The remaining required elements of this SAP are common to all of the SAPs prepared for OU 1148. These common elements are listed in Table 5.2-10 and are located in Appendix B of this RFI Work Plan.

5.2.4.2.7 Phase II SAP

Phase II sampling of surface sediment will be conducted at MDA H if Phase I sampling results indicate that COCs exceed health risk-based concentrations. The Phase II sampling will determine the extent of contamination in the drainageway. If Phase II sampling is required, then up to nine composite samples will be collected at the sample nodes where COCs exceeded the health risk-based criteria in Phase I. These samples will be collected from a depth of 6-12 in and analyzed for the COCs

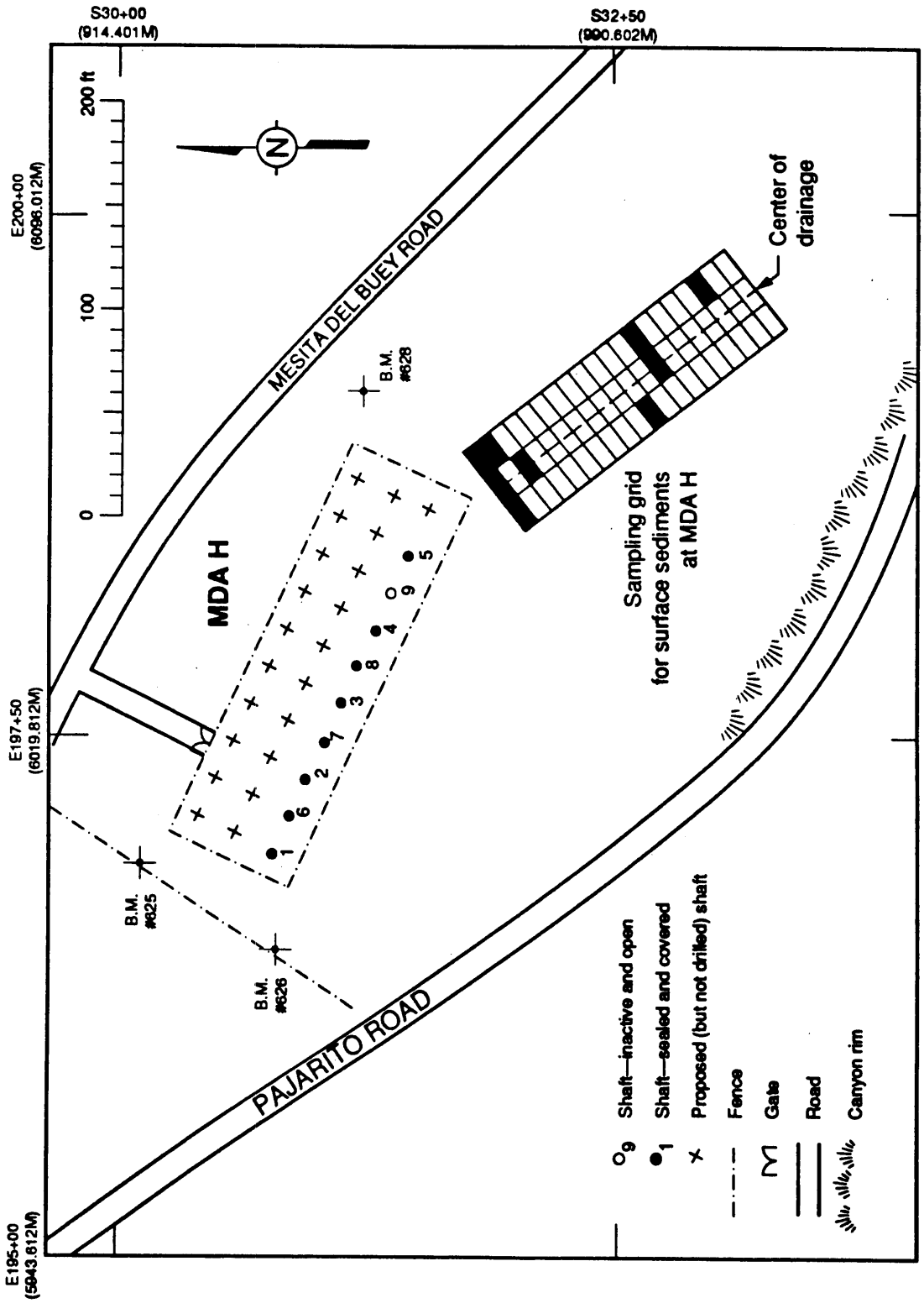


Figure 5.2-5 Surface sediment sampling locations at MDA H.

TABLE 5.2-12
PHASE I SAMPLING AND ANALYSIS PLAN TABLE FOR SURFACE SEDIMENT SAMPLING AT MDA H

Media	# of Samples	# of QC[a] Samples	Total Samples	Analysis
Soil	9	4	13	VOCs SVOCs Metals Pesticides PCBs Cyanide Tritium Gross Alpha Gross Beta Gamma Spectroscopy

[a]Includes Trip Blank, Field Blank, Duplicate Sample, and Equipment (Rinsate) Blank.

Trip Blank: Two 40 ml VOC sample containers filled with organic-free water at the Sample Coordination Facility. Filled trip blanks accompany sample bottles to the field, remain unopened throughout the sampling activity, and return with shipment to the analytical laboratory. Submitted only when sampling for VOCs.

Field Blank: Organic-free water is poured into sample containers at the sampling site.

Duplicate Sample: Collect two separate surface soil samples simultaneously.

Equipment (Rinsate) Blank: Obtained by running organic-free water over cleaned, decontaminated sampling equipment. Rinse the equipment surface that comes into contact with a sample.

TABLE 5.2-13
PHASE II SURFACE SEDIMENT SAMPLING AT MDA H

Phase II Media	Sampling	Rationale	Analysis	# of Samples
Sediment	Up to 9 locations, 6-12 inches in depth	Sample if COCs exceed health risk-based criteria during Phase I sampling.	COCs	9 + 4 QCs 13 Total

present in the corresponding Phase I sediment sample. Table 5.2-13 summarizes the Phase II samples and analytical requirements.

5.2.4.2.8 Health and Safety

This SAP will follow the procedures outlined in the Laboratory's Environment, Safety and Health Manual (LANL 1990, 0335) and Annex III of this RFI Work Plan.

5.2.4.3 Vertical Borehole Sampling at MDA H

5.2.4.3.1 Sampling and Analysis Components

The purpose of collecting and analyzing samples from boreholes at MDA H is to collect technically accurate and legally defensible data which can be used to characterize the nature of any contaminant releases at MDA H. The sampling component of this task consists of drilling vertical boreholes to collect continuous rock core and soil gas samples for chemical and radiological analyses. The analytical component consists of field and laboratory analysis of rock core and soil gas samples. Soil gas samples will be screened in the field for VOCs. Rock core samples will be screened in the field for VOCs and gross alpha, gross beta, and gross gamma ionizing radiation. Analysis at a contracted laboratory will be conducted on core samples for VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, and gross alpha, gross beta, and gamma emitters. Soil gas samples will be analyzed at a contract laboratory for VOCs. The data will be validated according to EPA functional guidelines for organic analysis (EPA 1988, 0293) and inorganic analysis (EPA 1988, 0296). Validation is necessary so that the quality of the data will be such that they can be used in risk assessment calculations. Currently, there are no published EPA methods for validating all radionuclide analyses.

5.2.4.3.2 Sampling and Analysis Approach

A phased drilling approach will be used to characterize subsurface contamination at MDA H. Rock core and soil gas samples will be collected from the Phase I boreholes at MDA H. A continuous suite of rock core samples will be collected using hollow stem auger drilling techniques. Soil gas samples will be collected from sections of each borehole isolated and sealed by a packer. Samples of soil gas will be collected using resin tubes or the TO-14 gas canister method (SUMMA®) in the grab sample mode.

Rock core and soil gas samples will be analyzed by EM-9 or will be shipped to a Laboratory-contracted environmental laboratory for analysis. All analyses for hazardous constituents will be performed according to EPA SW-846 (third edition) protocol. Analyses with tentatively identified compounds (TICs) will be reported in Level III SW-846 packages for subsequent data validation. Level V analysis for gross alpha, gross beta, and gamma emitters will use the current Laboratory-approved contractor or EM-9.

5.2.4.3.3 Primary Data Quality Factors

5.2.4.3.3.1 Prioritized Data Uses

The data to be collected are necessary for site characterization and risk assessment.

- Site Characterization - Trace levels of tritium were detected in subsurface samples taken near one of the shafts in MDA H. However, the data do not include information on all of the regulated compounds. Data for VOCs, SVOCs, metals, pesticides, PCBs, cyanide, and gross alpha, gross beta, and gamma emitters are not included in the data base. Data will be collected to fill existing data gaps and to support the validity and use of the existing data base.

- Risk Assessment - The data collected for site characterization will be used as input to a health risk-based assessment.

5.2.4.3.3.2 Appropriate Analytical Levels

Samples collected will be analyzed by a laboratory using SW-846 protocol. PIDs, FIDs, and ECDs will be used in the field to screen for organic vapors immediately after samples have been collected. A field GC, in a mobile laboratory, will be used along with a PID or FID to qualitatively determine the hazardous constituents present.

Radiological screening of samples will be conducted for gross alpha contamination and beta and gamma radioactivity. Screening for beta and gamma radiation will be conducted with a hand-held sodium iodide detector (NaID) probe and rate meter, or equivalent system. Screening for gross alpha contamination will be conducted with a hand-held alpha scintillation detector (ASD) and rate meter, or equivalent system. A windowless gas flow proportional (GFP) counter and a liquid scintillation counter in a mobile laboratory will be used for radiological screening, in addition to screening with the hand-held detectors. The field screening and analytical levels include:

Level I Field Screen: PID/FID Instruments; NaID/ASD Instruments,

Level II Field Analysis: Field GC with PID/FID/ECD; Windowless GFP Counter; and Liquid Scintillation Counter,

Level III SW-846 Laboratory Methods, and

Level V Radionuclide Analysis Laboratory Methods.

5.2.4.3.3.3 Primary Contaminants of Concern

The contaminants of concern at MDA H are VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, and gross alpha, gross beta, and gross gamma emitters.

5.2.4.3.3.4 Levels of Concern

Appendix F of the IWP (LANL 1991, 0553) and 40 CFR 264, Proposed Subpart S, contain information on constituent levels of concern. Health risk-based determinations of levels of concern will be developed for constituents not listed in Appendix F. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 IWP. This approach will be developed in adequate time for data analysis.

5.2.4.3.3.5 Required Quantitation Limits

Quantitation limits for laboratory analysis of hazardous substances and radionuclides are presented in Tables V.3 through V.9 of the Laboratory's Generic QAPjP (LANL 1991, 0412).

5.2.4.3.3.6 Critical Samples

Samples collected from the vertical boreholes located around the perimeter of MDA H are important in detecting and characterizing contaminant releases to the subsurface.

MDA H is rectangular in shape and contains nine 6-ft-diameter shafts. MDA H is enclosed by a chain-link fence. One vertical borehole will be drilled on each side of MDA H for a total of four boreholes. The boreholes will be located outside of the fenced area and centered on each side to determine the absence or presence of contamination and the potential for subsurface migration from the site.

5.2.4.3.4 Rationale for Sampling Activity

The reasons for installing the four vertical boreholes are:

- to determine if COCs are present and migrating beyond the point of institutional controls; and
- to characterize permeable geologic features as preferential lateral migration pathways.

Data obtained through implementation of this Phase I SAP will be used for the initial characterization of the nature, extent, and source of any residual soil or rock contamination in the subsurface at MDA H. This information will be obtained through the following sampling task:

Task 1. Borehole Installation

- Four vertical boreholes will be installed to determine the absence or presence of contaminants in the subsurface at the perimeter of MDA H (see Figure 5.2-6 for the proposed borehole locations).
- Core samples will be collected and analyzed for VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, and gross alpha, gross beta, and gamma emitters by EM-9 or by a contract analytical laboratory that is certified to perform SW-846 analyses.
- Soil gas samples will be collected using resin tubes or SUMMA® canisters as the boring is advanced, and analyzed for VOCs by EM-9 or by a contract analytical laboratory that is certified to perform SW-846 analyses.

5.2.4.3.5 Sampling Activity

5.2.4.3.5.1 Boreholes at MDA H

Four vertical boreholes will be installed during the Phase I sampling program. These boreholes will be drilled to a depth of approximately 70 ft. The boreholes will be advanced to a depth necessary to intercept and drill 10 ft beyond the surge bed (a permeable geologic feature), estimated to be 60 ft deep beneath MDA H. The actual depth of the vertical boreholes may vary, depending on the results of field analyses of soil, rock core, and soil gas. All vertical boreholes will be advanced until no radiological contaminants or VOCs are detected by field screening techniques. The locations of the four proposed boreholes are shown on Figure 5.2-6. Table 5.2-14 is a sampling summary of the vertical boreholes at MDA H. It lists the sampling interval for each media along with the analyses to be performed and the corresponding analytical level. A detailed tabulation of environmental and quality control (QC) sample intervals and corresponding analyses for each borehole is presented in Table B.3-2 of Appendix B. The ratio for QC samples for sample collection activities is presented in Table B.10-1 of Appendix B. Table 5.2-15 summarizes the number of environmental and QC samples to be collected at MDA H and explains the types of QC samples.

The procedures for borehole installation and logging, sample collection (rock core) from the vertical boreholes, field screening analysis, hydrogeologic measurements, and waste disposal and borehole abandonment are described in Section 3.0 of Appendix B. Soil gas sample collection procedures, surveying and monitoring, and field screening procedures are presented in Section 6.0 of Appendix B.

5.2.4.3.6 Remaining SAP Elements

The remaining required elements of this SAP are common to all of the SAPs prepared for OU 1148. These common elements are listed in Table 5.2-10 and are located in Appendix B of this RFI Work Plan.

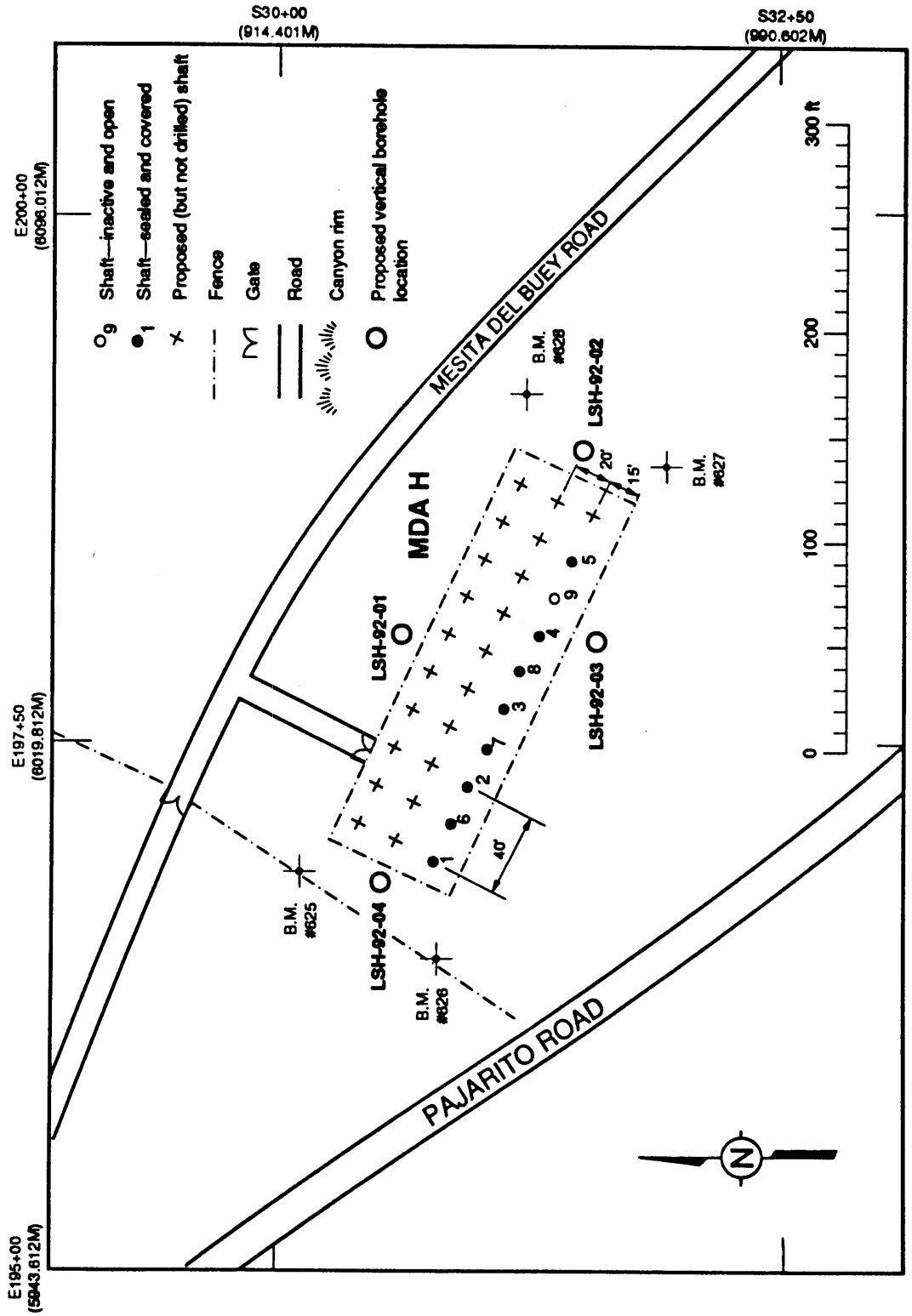


Figure 5.2-6 Location map of proposed vertical boreholes at MDA H.

TABLE 5.2-14
SAMPLING SUMMARY FOR VERTICAL BOREHOLES AT MDA H

Analytical Level	Sampling[a] Interval	Analysis	Medium
Laboratory Analysis			
Level III	20 ft	VOCs	Rock Core
Level III	20 ft	SVOCs	Rock Core
Level III	20 ft	Metals	Rock Core
Level III	20 ft	Pesticides	Rock Core
Level III	20 ft	PCBs	Rock Core
Level III	20 ft	Cyanide	Rock Core
Level V	20 ft	Gross Alpha and Gross Beta, Gamma Spectroscopy	Rock Core
Level III	20 ft	VOCs	Vapor
Level V	20 ft	Tritium	Rock Core
Field Screening or Analysis			
Level I	5 ft	Organic Vapors (PID/FID)	Rock Core
Level II	5 ft	Organic Vapors (Field GC)	Rock Core
Level I or II	5 ft	Alpha, Beta, & Gamma Emissions	Rock Core
Level II	5 ft	Gravimetric moisture	Rock Core

[a] A sample will be collected at a minimum spacing of 20 ft for analyses to confirm the absence or presence of COCs above the health risk-based criteria. The actual depth of the sample will be determined from the field screening and observation.

TABLE 5.2-15
PHASE I SAMPLING AND ANALYSIS PLAN TABLE FOR VERTICAL BOREHOLE SAMPLING AT MDA H

Media	# of Samples	# of QC[a] Samples	Total Samples	Analysis
Soil/Rock Core	24	32	56	VOCs SVOCs Metals Pesticides PCBs Cyanide Tritium Gross Alpha Gross Beta Gamma Spectroscopy
Soil Gas	24	32	56	VOCs

(a) Includes: Trip Blank, Field Blank, Duplicate Sample, and Equipment (Rinsate) Blank.

Trip Blank (Soil/Rock Core): Two 40 ml VOC sample containers filled with organic-free water at the Sample Coordination Facility. Filled trip blanks accompany sample bottles to the field, remain unopened throughout the sampling activity, and return with shipment to the analytical laboratory. Submitted only when sampling for VOCs.

Trip Blank (Soil Gas): A sealed SUMMA® canister or resin tubes taken to the field during a sampling event and returned with shipment to the analytical laboratory. Canister or tubes remains unopened.

Field Blank (Soil/Rock Core): Organic-free water is poured into sample containers at the site of the borehole sampling.

Field Blank (Soil Gas): A SUMMA® canister or resin tubes exposed to the atmosphere near the sampling site. The canister or tubes will be left open until 3 liters of air are sampled.

Duplicate Sample (Soil/Rock Core): Collect two separate core samples immediately adjacent to each other by the same sampling technique.

Duplicate Sample (Soil Gas): Obtained by attaching two SUMMA® canisters or four resin tubes to the sample line with a Y fitting and filling the canisters or tubes simultaneously.

Equipment (Rinsate) Blank (Soil/Rock Core): Obtained by running organic-free water over cleaned, decontaminated sampling equipment. Rinse the equipment surface that comes into contact with a sample.

Equipment (Rinsate) Blank (Soil Gas): A gas sample, using a SUMMA® canister or resin tubes, is taken to assess the cleanliness of the sample manifold. Clean the sample manifold, fill a 6L Teflon® bag with zero-zero air, and attach the bag and a canister or resin tubes to the manifold. Collect 3 liters using a flow rate of 500 ml/minute.

5.2.4.3.7 Phase II SAP

Migration of COCs beyond the boundary of MDA H is not anticipated. However, if COCs are detected in the subsurface at levels exceeding health risk-based criteria, Phase II sampling will be conducted at MDA H. Two additional boreholes may be needed to further characterize the nature and extent of potential contaminant migration. Six samples will be collected from each borehole: two from 10 and 5 feet above any preferential geologic pathway; two from within the surge bed; and two from 5 and 10 feet below the surge bed. Additionally, two more boreholes may be drilled down dip of a Phase I borehole if concentrations of COCs within the surge bed or cooling fracture zone at Phase I borehole locations exceed health risk-based criteria. Table 5.2-16 summarizes the number of samples and analytical requirements for the Phase II sampling activities.

5.2.4.3.8 Health and Safety

This SAP will follow the procedures outlined in the Laboratory's Environment, Safety and Health Manual (LANL 1990, 0335) and Annex III of this RFI Work Plan.

5.2.4.3.9 Schedule

See Annex I.

5.2.4.4 Air Sampling for Tritium at MDA H

Tritium (^3H, or T) is produced naturally in the upper atmosphere by cosmic irradiation, and as a fission or neutron activation product in nuclear reactors. Tritium can exist in the gas phase as HT or T_2; however, tritium oxidation and exchange reactions with H_2O produce tritiated water, HTO, the most common form of environmental tritium (NCRP 1979, 0739). Uptake of inhaled or ingested HTO is rapid and 99% efficient (NCRP 1979, 0739). Although inhalation exposure of people to HT gas might occur, uptake is inefficient and only 0.004% of the inhaled HT is absorbed after oxidation to HTO. Thus, it would require approximately 25,000 ppm of HT in air to pose the same hazard as 1 ppm HTO. Therefore, this SAP is directed toward detection of airborne tritiated water vapor.

5.2.4.4.1 Sampling and Analysis Components

The purpose of collecting air samples for tritium analysis at MDA H is to collect technically accurate and legally defensible data. This SAP is designed to obtain information on tritium air concentrations and transport in the environment around MDA H that is necessary to support the DQO decisions.

TABLE 5.2-16
PHASE II VERTICAL BOREHOLE SAMPLING AT MDA H

Media	Phase II Sampling	Rationale	Analysis	# of Samples
Rock Core	2-4 locations	Sample if COCs exceed health risk-based criteria during Phase I.	COCs	12 + 16 QCs 28 Total or 24 + 32 Qcs 56 Total
Soil gas	2-4 locations	See above.	VOCs	See above.

5.2.4.4.2 Sampling and Analysis Approach

Because environmental tritium occurs as tritiated water, tritium sampling methods have been developed to isolate and analyze moisture, often in vapor form (NCRP 1976, 0738). Airborne tritiated water vapor is absorbed by a desiccant, isolated by distillation, and measured by liquid scintillation counting.

5.2.4.4.3 Primary Data Quality Factors

5.2.4.4.3.1 Prioritized Data Uses

The data to be collected are necessary for site characterization and risk assessment.

- Site Characterization - Based on the tritium analyses of samples collected at Area H by J.W. Aeby in 1969 and 1973 (Krueger 1991, 08-0042) (Tables 5.2-3 and 5.2-4), there is tritium present above background in the environment at MDA H. There are three potential pathways for the tritium to move beyond the point of institutional control: the air pathway for vapor/dusts/gas, subsurface migration as a vapor, and surface runoff of tritiated water. The air pathway and subsequent inhalation by an area resident has a higher probability of occurring than the water borne pathway and subsequent ingestion of soil by an area resident. To determine if there is in fact an air pathway, Phase I air sampling for tritium will be conducted. If the tritium analytical results indicate that tritium is above a health risk-based criteria of 1×10^{-7} µCi/ml in the air samples, then a Phase II sampling program will be conducted to determine the source of the tritium (i.e., which shaft or shafts).

- Risk Assessment - Source term data for tritium are needed to determine the surface emanation rate of tritium for unit risk calculations and to provide source term data for flow and transport modeling using TRACR3D.

5.2.4.4.3.2 Appropriate Analytical Levels

The sampling and analysis methods described in Section 5.0 of Appendix B correspond to Level V analytical methods and will be used throughout this SAP. Because these tritium measurements correspond to Level V, the Phase I sampling and analysis effort will be directed toward determining the locations of greatest contamination, and providing concentration and emanation data as needed to support risk assessments.

5.2.4.4.3.3 Primary Contaminant of Concern

Tritium in the form of airborne tritiated water vapor (HTO) is the constituent of primary concern for this sampling activity at MDA H.

5.2.4.4.3.4 Levels of Concern

The DOE Derived Concentration Guide for tritium in uncontrolled areas is 1×10^{-7} µCi/ml in air. DOE Order 5280.2A requires that the radiation exposure of the general public from waste disposal activities will not exceed 100 mrem/yr.

5.2.4.4.3.5 Required Quantitation Limits

The quantitation limit concentration for tritium in air is 1×10^{-10} µCi/m³ (Environmental Protection Group 1990, 0497). This quantitation limit concentration corresponds to an annual dose of 60 rem, which is 0.06% of the 100 mrem/yr equivalent dose limit specified in DOE Order 5280.2A

5.2.4.4.3.6 Critical Samples

Airborne tritium samples, collected as HTO vapor, are critical to site characterization and risk assessment efforts.

5.2.4.4.4 Rationale for Sampling Activity

Samples of airborne tritium as HTO vapor will be critical to site characterization and to the development of tritium vapor transport models which will support risk assessment activities.

5.2.4.4.5 Sampling Activity

Air tritium samples will be collected with silica gel columns as described in Section 5.0 of Appendix B. A minimum of 3 m³ of air will be collected for each air tritium sample. This volume represents approximately the volume required to allow the Detection Limit Concentration of 1×10^{-10} µCi/m³ (Environmental Protection Group 1990, 0497, Table C-26). One sample will be collected within a 17-day period each month for one year from the location shown on Figure 5.2-7, for a total of 12 samples. Table 5.2-17 lists the number of samples, the number of QC samples, and the analytical requirements for the Phase I investigation. It also describes the types of QC samples required.

No tritium screening will be done in the field. Routine screening in the field for alpha and beta/gamma emitters will be done as a preliminary indicator of radiological contamination. Field instruments, such as the "Violinist", which is available from HS-12, can be used to detect alpha emitters by detecting the related gamma emissions. This instrument is an upgrade of the "Fidler" instrument.

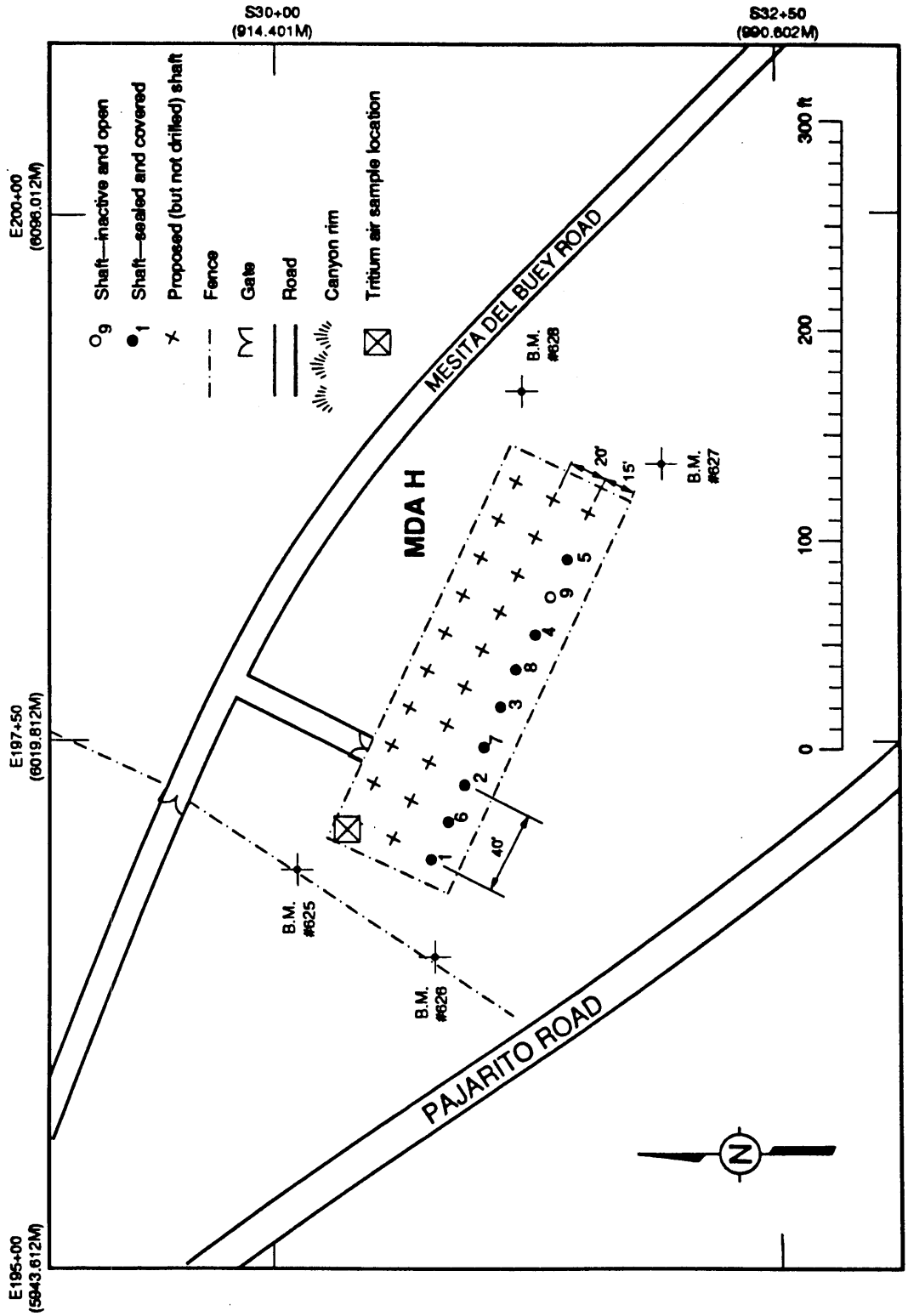


Figure 5.2-7 Tritium air sampling location at MDA H.

TABLE 5.2-17
PHASE I SAMPLING AND ANALYSIS PLAN TABLE FOR AIR SAMPLING FOR TRITIUM AT MDA H

Media	# of Samples	# of QC[a] Samples	Total Samples	Analysis
Air (Silica Gel)	12	24	36	Tritium

[a] Includes Field Blank and Duplicate Sample.

Field Blank: Collect the sample by exposing a silica gel column for a 17-day period. Select a site far enough away from the contaminated area to assess field conditions at the site.

Duplicate Sample: Fill two silica gel columns simultaneously at the same sampling area.

5.2.4.4.6 Remaining SAP Elements

The remaining required elements of this SAP are common to all of the SAPs prepared for OU 1148. These common elements are listed in Table 5.2-10 and located in Appendix B of this RFI Work Plan.

5.2.4.4.7 Phase II SAP

If tritium air concentrations exceed health risk-based criteria during the Phase I investigation, then soil samples will be collected for tritium analysis at MDA H. Soil samples will be collected at 9 nodes on an MRI grid and analyzed for HTO. If these soil samples exceed the health risk-based criteria, then vegetation samples will be collected at the same locations. Table 5.2-18 summarizes the Phase II sampling plan for MDA H.

5.2.4.4.8 Health and Safety

This SAP will follow the procedures outlined in the Laboratory's Environment, Safety and Health Manual (LANL 1990, 0335) and in Annex III of this RFI Work Plan.

5.2.4.4.9 Schedule

See Annex I.

TABLE 5.2-18
PHASE II AIR (SOIL) SAMPLING FOR TRITIUM AT MDA H

Media	Phase II Sampling	Rationale	Analysis	# of Samples
Soil	9 locations	Sample if tritium levels exceed health risk-based criteria during Phase I.	Tritium	9 + 4 QCs 13 Total
Vegetation	See above.	See above.	Tritium	9 + 2 QCs 11 Total

5.3 Material Disposal Area L

5.3.1 Background

5.3.1.1 Description and History of SWMU Aggregate

MDA L is a 2.58-acre site within TA-54 that was historically used as a disposal site for hazardous chemicals. Land disposal stopped in 1985. It is presently used for RCRA-permitted chemical waste storage and treatment, and for mixed waste storage under interim status authority. The MDA is located on flat land on top of Mesita del Buey and is surrounded by a security fence. Surface water runoff from MDA L is directed to a single discharge point through a flume that discharges down the mesa wall into Cañada del Buey. MDA L will be treated as a single SWMU Aggregate for the purpose of investigation under the ER Program. A brief description of the SWMUs in MDA L is listed in Table 5.3-1 and presented below.

Surface Storage and Treatment Units

Hazardous, nonhazardous, and mixed wastes are presently managed at MDA L. No disposal occurs at MDA L; wastes are stored in various units or treated in tanks. Hazardous waste management operations are currently conducted under a RCRA operating permit; mixed waste is managed under interim status authority. A description of solid waste management units follows. The surface storage and treatment units are shown on Figure 5.3-1.

Mixed Waste Storage Area/Old Hazardous Waste Storage Area [54-001(a)]

MDA L contains a low-level mixed waste storage area that is presently used to store liquid waste containing both a hazardous waste and a radioactive component, as defined by the EPA. Previously, the location was used for storage of hazardous waste. The storage area is identified as SWMU 54-001(a). The waste storage area dimensions are approximately 150 ft by 40 ft. It is constructed over Pit A on an asphalt pad.

All wastes stored at MDA L are segregated into compatible chemical groups to prevent adverse reactions should an accidental spill occur. Drums of mixed waste are overpacked with an absorbent material filling the void space. The overpacked drums are stored on pallets or other platforms, stacked up to three drums high, with a pallet between the layers as well as below the first layer. Drums containing liquid scintillation vials have a 30 gal capacity and contain absorbent along with the vials. These can be stacked three drums high with pallets between the layers. Adequate aisle space is maintained, and the area is posted as a radiation area. Typically, drums of hazardous (non-mixed) waste are overpacked with an absorbent material filling the void space. The overpacked drums are stored on pallets or other platforms and stacked up to two drums high, with a pallet between the layers as well as below the first layer.

TABLE 5.3-1
SWMUs IN TA-54, MDA L[a]

SWMU	Description	HSWA Permit Table A or B	Status	Recommendation
54-001(a)	Bermed storage area for pails/drums over inactive Pit A	A	RCRA Interim Status, Active	Phase I Investigation[b]
54-001(b)	Mixed waste container packaging/storage		RCRA Interim Status, Active	Phase I Investigation[b]
54-001(c)	Former location of bermed storage pad for waste oil/hazardous materials storage (never used)	A	Inactive, never used	NFA; see Chapter 6
54-001(d)	PCB storage/treatment		TSCA Permitted, Active	Phase I Investigation
54-001(e)	Six-celled concrete pad for bulk waste storage		RCRA Permitted, Active	Phase I Investigation[b]
54-002	Compressed gas cylinder storage		RCRA Permitted and RCRA Interim Status, Active	Phase I Investigation[b]
54-006	Disposal pits/shafts/impoundments	A	Inactive	Phase I Investigation
54-008	Septic tanks		NMED Permitted, Active	NFA; see Chapter 6
54-009	Treatment tanks		RCRA Permitted, Active	Phase I Investigation[b]
54-012(b)	Drum compactor		Active	Phase I Investigation[b]
54-014(a)	Lead stringer storage shafts		RCRA Interim Status, Active	Phase I Investigation
54-015(g)	Former site of U-contaminated lead cask surface storage		Inactive; Material moved to MDA G	NFA, see Chapter 6
54-015(i)	Former site of radioactively-contaminated forklift battery storage		Inactive; Material moved to MDA G	NFA; see Chapter 6
	Hazardous Waste Safety Storage Units[c]		RCRA Permitted; Active	Phase I Investigation[b]
	Former Site of Waste Oil Storage Tanks[c]		Tanks moved to MDA G; Inactive	Phase I Investigation[b]

[a] EPA 1990, 0306

[b] NMED Closure Plan Modification

[c] Not listed as a SWMU in EPA 1990, 0306

NFA = No Further Action

of 16,720 gal, or 304 55-gal drums. It is covered by a metal roof and has a sheet metal wall along its northwest side. Fiberglass or metal grating lies above the floor of each cell so that waste drums are elevated several inches above the floor. The floor of each cell slopes toward a sump. The secondary containment volume is significantly greater than the required 10% of maximum volume of liquid waste stored on the pads. The concrete pads are coated with a sealant and maintained in good condition. They are inspected weekly, and no releases have been identified.

Gas Cylinder Storage (54-002)

MDA L provides for storage of containerized gases until they can be treated and/or disposed of off site. The cylinders (SWMU 54-002) are stored in racks along the southern and eastern fence line in the eastern part of MDA L. The gases are classified as mixed, hazardous, and nonhazardous wastes. They are managed in compliance with the RCRA permit or RCRA interim status and are handled in a manner that meets Laboratory safety requirements. Most of the gas cylinders stored at MDA L have had their contents analyzed and are awaiting shipment off site for final disposition. From July 1990 to July 1991, the Laboratory was involved in a project to retrieve and identify waste compressed-gas cylinders throughout the Laboratory. A group of cylinders, the contents of which are unknown, is being stored indefinitely at MDA L until their contents can be analyzed and the cylinders treated and/or disposed of off site. In the past, hazardous releases have occurred from gas cylinders, though no radioactive releases have been documented. Leaking gases have been contained within cylinder overpacks.

Treatment Tanks (54-009)

Barium-contaminated sand from burn pads located at other areas of the Laboratory are treated in four 1,665-gal carbon steel open-top tanks (SWMU 54-009). The tanks were installed in 1988. They are 9 ft in diameter and 3.5 ft high. One 210 gal mixing tank constructed of stainless steel is also present. All five tanks are located on a bermed concrete pad with a containment capacity of 3,554 gal.

The tanks, operated in compliance with the Laboratory's RCRA permit, are used primarily to treat sands containing barium in excess of TCLP limits. Barium is precipitated as a nonhazardous (barium sulfate) salt in the tanks, drummed, and shipped to MDA J. The treated sand is also disposed of at MDA J. In the past, the tanks were used to treat ammonium bifluoride, neutralize acids and bases, and oxidize reactive wastes. However, due to safety considerations, the tanks are no longer used for these purposes. No releases have been identified from this active SWMU.

Drum Compactor [54-012(a)]

A drum compactor [SWMU 54-012(b)] designed to crush discarded 55- and 30-gal drums is located at MDA L. The drum compactor uses hydraulic pressure to move a ram and crush the drums. The hydraulic lines are sleeved to prevent injury or damage if a line breaks. Before using the drum compactor, operators inspect the equipment and the connections for the hydraulic lines and ensure that a drip pan is located under the compactor. In the past, the drum compactor was located on bare soil that exhibited staining. The drum compactor was moved to the present location

in late 1989 or early 1990, and the stained soil has been removed (Benchmark 1991, 08-0039). No documentation of the soil removal could be obtained.

The drum compactor is presently on a concrete containment pad that retains any residual liquids that may leak from drums during crushing. Crushed waste drums may contain chemicals, including liquids, that are not contaminated with radionuclides. All containers must be empty according to the RCRA definition prior to crushing. During a site visit in September 1991, the drain pan had pooled fluid which was dripping on the ground (Benchmark 1991, 08-0039).

Lead Stringer Storage Shafts [54-014(a)]

Lead stringers are stored in two shafts at the northwest corner of MDA L [SWMU 54-014(a)]. Lead stringers are steel rods filled with irradiated lead and concrete. One shaft is 30 ft deep and has a metal liner and a concrete bottom. No information is available regarding the construction design of the second shaft. The two shafts are capped with a concrete shielding block. The shafts are managed under RCRA interim status authority as container storage units. The locations of lead stringer storage shafts are shown on Figure 5.3-1.

Hazardous Waste Safety Storage Units

MDA L stores both solid and liquid hazardous wastes in three safety storage units: TA-54-68, TA-54-69, and TA-54-70 (Figure 5.3-1). All three buildings are roofed and bermed modular units measuring 22.75 ft long, 9 ft wide, and 8.75 ft high, with a maximum capacity of 2,200 gal, or 40 55-gal drums. The units are used for storage of labpacked wastes. Each unit includes a secondary spill-containment reservoir in the subfloor and a fire-suppression system. The walls, ceiling, and reservoir are constructed of welded steel with supporting structural steel sections; the flooring is epoxy-coated, fire-resistant plywood. The reservoirs have a 570 gal capacity, are lined with a polyethylene liner, and are covered with coated steel floor grating. The units have either one or two internal separation walls. No releases have been identified.

These units were not listed as SWMUs in the Solid Waste Management Units Report (LANL 1990, 0145). They are RCRA-permitted and will be subject to NMED closure requirements.

Former Location of Waste Oil Storage Tanks (Area of Concern)

With the oral approval of NMED, six above-ground storage tanks containing waste oil were pumped out in 1989 and were moved from MDA L to MDA G to make room for new facilities. There were four 771-gal fiber glass tanks, one 5,650-gal rectangular tank in Impoundment D, and one 5,086-gal tanker trailer that was parked next to the rectangular tank. Although closure of these tanks was originally scheduled that same year, it was delayed until 1990 because NMED had not approved the closure plan in 1989.

In early 1990, the Waste Management Group (EM-7) expressed a desire to remediate the tanks as soon as possible (for housekeeping purposes and to increase space in MDA L). In order to decontaminate the tanks as quickly as possible, it was

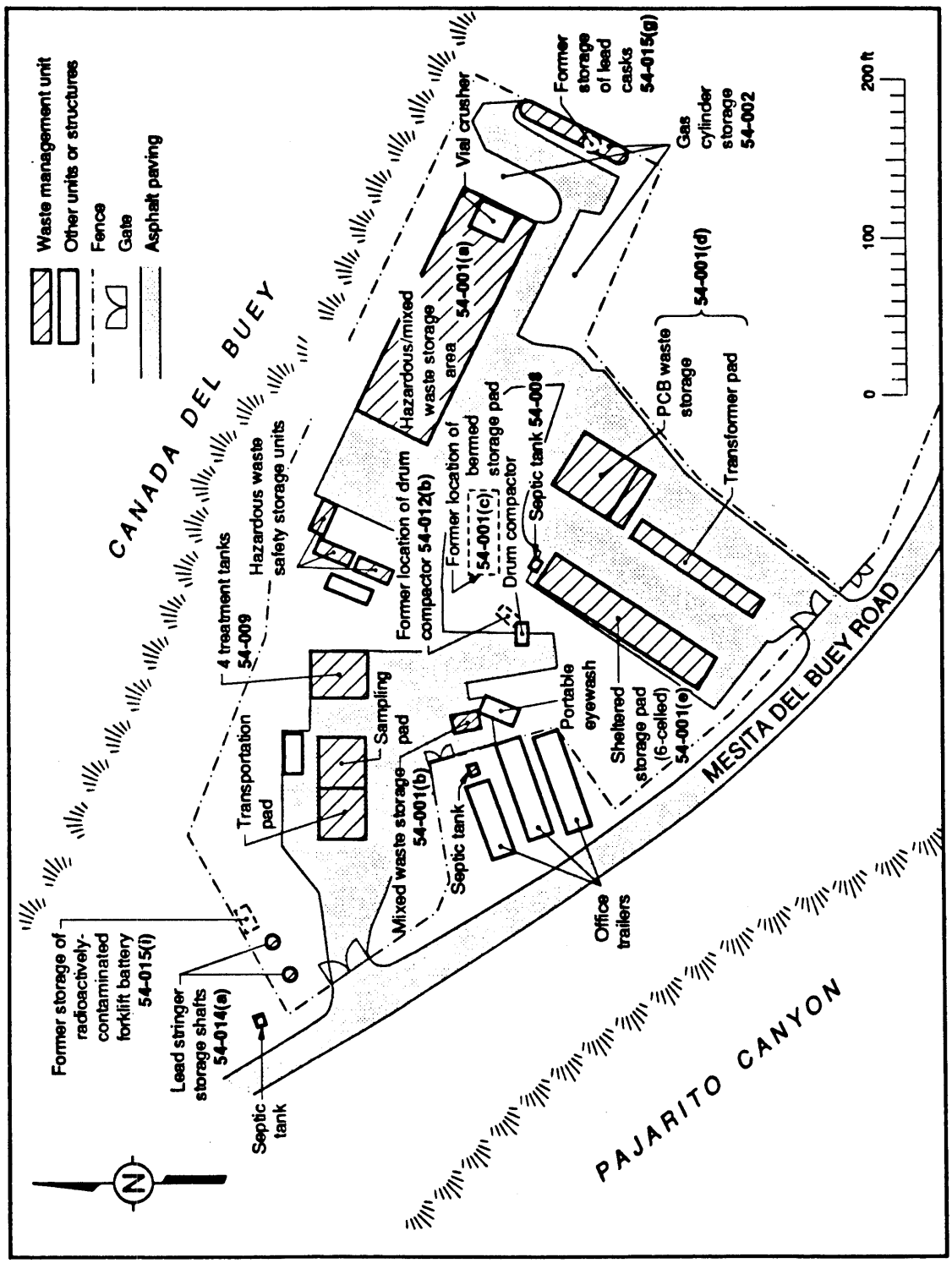


Figure 5.3-1 Location map of Solid Waste Management Units at MDA L (see Fig. 5.3-2 for location of SWMU 54-006). (Base map modified from Benchmark Environmental Corp. 1991.)

Drums of solid hazardous waste are stored on pallets in the open area throughout MDA L, as allowed by permit, but no closer than 5 ft to the fence or any permanent structure. The maximum volume of hazardous wastes that may be stored in the open area is 198,000 gal (3,600 55-gal drums). No releases have been identified at this active SWMU.

Container Accumulation, Packaging, and Storage Area [54-001(b)]

Chemical waste containers are accumulated for packaging and storing at TA-54-31 [SWMU 54-001(b)]. The building is 13.5 ft by 14.5 ft and has a total storage capacity of 440 gal, or eight 55-gal drums. Secondary containment mechanisms are present inside the building in the form of three shallow sumps, 6 in deep; one is 7 ft by 6 ft, and the other two are 6 ft by 4 ft. The outside of the building is surrounded by a paved drainage diversion ditch to prevent run-on. No releases have been identified at this active SWMU.

Polychlorinated Biphenyls (PCBs) [54-001(d)]

PCB-contaminated wastes are stored at MDA L until final disposition. The unit, SWMU 54-001(d), consists of a PCB building (TA-54-39) and a PCB storage pad (TA-54-81). The building is a roofed structure measuring 40 ft by 40 ft. The PCB building has a design storage capacity of 20,000 gal of waste stored in 55-gal drums. The building has a bermed concrete floor forming a sump. Ramps are built into the floor at all entrances. The building has a foam fire-suppression system with temperature sensors to automatically trigger the system. The bermed concrete storage pad is covered and has a sheet metal back wall. The storage pad measures 59 ft by 17 ft. It has a capacity of 8,000 gal and incorporates a secondary containment system.

Typical materials handled at the facilities include transformer and capacitor oil contaminated with PCBs, carcasses from transformers and capacitors, debris, protective clothing, soil contaminated with PCBs, and storm water from secondary containment systems around above-ground tanks. Ultimately, liquids such as PCB-contaminated capacitor oil are incinerated at a permitted facility; solids such as transformers are decontaminated off site using a vapor-solvent extraction technique. The decontaminated transformer carcasses are either landfilled or taken to a smelter for metal recycling. No known releases are associated with this SWMU (IT Corporation 1991, 08-0021).

The PCB building and storage pad are operating under a current Toxic Substances Control Act (TSCA) approval letter issued by the EPA in June 1980. A new approval letter, anticipated in November 1992, is expected to include a requirement for a formal closure plan for this site. The site will be investigated under the closure plan when the PCB facility is relocated to TA-61 after the year 2000. Phase I Sampling and Analysis Plans (SAPs) include analyses for PCBs to investigate migration away from the MDA.

Sheltered, Six-Celled Concrete Bulk Waste Storage Pad [54-001(e)]

TA-54-32 [SWMU 54-001(e)] is a concrete pad divided into six cells, each with a collection sump. The pad was built in 1987. It is 15.5 ft by 106 ft, and has a capacity

decided that the tank closure would not include any associated contaminated soil that may exist in MDA L; any of this contaminated soil would be treated during closure and corrective action at MDA L. The decontamination of these tanks was competed in 1990, and a closure report was submitted to NMED in June 1991. No further action will be recommended for the tanks themselves, but the absence or presence of contaminated soil at the former location of the tanks at MDA L will be investigated during closure of the surface treatment and storage units.

Subsurface Disposal Units (54-006)

Subsurface treatment, storage, and disposal (TSD) units were grouped together in the 1990 SWMU Report as SWMU 54-006 (LANL 1990, 0145). Land disposal units were operated at MDA L from the late 1950s until 1985. The land disposal units consist of an elongated pit (Pit A); three surface impoundments (Surface Impoundments B, C, and D); and a series of shafts (Shafts 1 through 34). Table 5.3-2 gives dates of use and capacities for the MDA L land disposal units. Locations of the pits, impoundments, and shafts are shown on Figure 5.3-2.

Disposal Pit

Pit A is located in the eastern portion of MDA L underlying the current mixed and hazardous waste storage area. The location of Pit A is shown on Figure 5.3-2. Pit A was used from the late 1950s through December 1978 (IT Corporation 1991, 08-0027). Pit A was the only disposal unit at TA-54 open before 1975 and received all chemical waste disposed of at MDA L during that time. The pit measures 200 ft long, 12 ft wide, and 12 ft deep (Table 5.3-2). Because no procedures were in effect during the early days of disposal, initial waste disposal practices for Pit A included disposing of noncontainerized wastes and liquids in drums without added absorbents (IT Corporation 1991, 08-0027).

Treatment and Disposal Surface Impoundments

Three unlined surface impoundments are located at MDA L and designated from east to west as Surface Impoundments B, C, and D. The dates of use and the capacities of these impoundments are listed in Table 5.3-2.

Available information indicates that Surface Impoundment B was excavated in 1978 and measured 10 ft wide, 20 ft long, and 10 ft deep. It was used from January 1979 through June 1985 to evaporate treated salt solutions, such as ammonium bifluoride, and electroplating wastes (IT Corporation 1991, 08-0027). Sampling conducted in 1985 to characterize the contents of Impoundment B measured cadmium and chromium in EP toxic concentrations (IT Corporation 1987, 0327).

Surface Impoundment C was excavated in the early 1980s. It measures 10 ft wide, 20 ft long, and 10 ft deep. According to J. Mascarenas (IT Corporation 1991, 08-0027), it was used from July 1985 through December 1986 for the same purposes that Surface Impoundment B was used. Surface Impoundment C was capped sometime between June 1987 and 1989.

Surface Impoundment D measures 10 ft wide, 20 ft long, by 10 ft deep, and was used to treat small batch quantities of lithium hydride by reacting it with water. The practice

TABLE 5.3-2
DATES OF USE AND CAPACITY FOR INDIVIDUAL PITS AND SHAFTS, MDA L

Pit, Shaft, or Impoundment		Start Date of Use[a]	End Date of Use	Number of Months in Use	Dimensions (ft) (width x length x depth for pits) (diameter x depth for shafts)	Total Capacity of Pit or Shaft (ft^3)
Pit	A	1950s	12/78	>228	200 x 12 x 12	28,800
Impoundment	B[b]	1/79	6/85	78	10 x 20 x 10	2000
Impoundment	C[b]	7/85	12/86	18	10 x 20 x 10	2000
Impoundment	D[b]	1972	1984	156	10 x 20 x 10	2000
Shaft	1[b]	4/80	8/83	41	3 x 60	424
	2	2/75	6/79	53	3 x 60	424
	3	2/75	10/78	45	3 x 60	424
	4	2/75	4/80	63	3 x 60	424
	5	2/75	5/77	28	3 x 60	424
	6	6/75	5/79	48	4 x 60	754
	7	6/75	5/79	48	3 x 60	424
	8	6/75	5/79	48	3 x 60	424
	9	6/75	5/79	48	3 x 60	424
	10	6/75	5/79	48	3 x 60	424
	11	1/78	6/79	18	8 x 60	3016
	12	1/78	6/79	18	4 x 60	754
	13[b]	6/79	4/82	35	8 x 60	3016
	14[b]	6/79	4/82	35	3 x 60	424
	15[b]	6/79	4/82	36	3 x 60	424
	16[b]	6/79	4/82	35	3 x 60	424
	17[b]	6/79	4/82	35	3 x 60	424
	18	6/79	5/80	12	8 x 60	3016
	19[b]	4/80	4/82	25	8 x 60	3016
	20[b]	3/82	8/83	18	3 x 60	424
	21[b]	3/82	12/85	46	3 x 60	424
	22[b]	3/82	8/83	18	3 x 60	424
	23[b]	4/82	2/84	23	4 x 60	754
	24[b]	4/82	3/84	24	4 x 60	754
	25[b]	9/82	4/85	32	6 x 60	1696
	26[b]	9/82	2/84	18	6 x 60	1696
	27[b]	1/83	1/85	25	4 x 60	754
	28[b]	1/82	4/85	40	4 x 60	754
	29[b]	12/83	7/84	8	6 x 65	1838
	30[b]	12/83	4/84	5	6 x 65	1838
	31[b]	12/83	8/84	9	6 x 61	1725
	32[b]	3/84	8/84	6	4 x 15	188
	33[b]	3/84	1/85	11	6 x 65	1838
	34[b]	2/85	4/85	3	6 x 63	1781

[a]Dates are from J. Mascarenas (IT Corporation 1991, 08-0027). Pits and shafts are considered "active" (i.e., receiving waste) during the entire month in which they were drilled, and "inactive" during the entire month in which they were capped.
[b]Impoundments and shafts subject to closure authority of NMED.

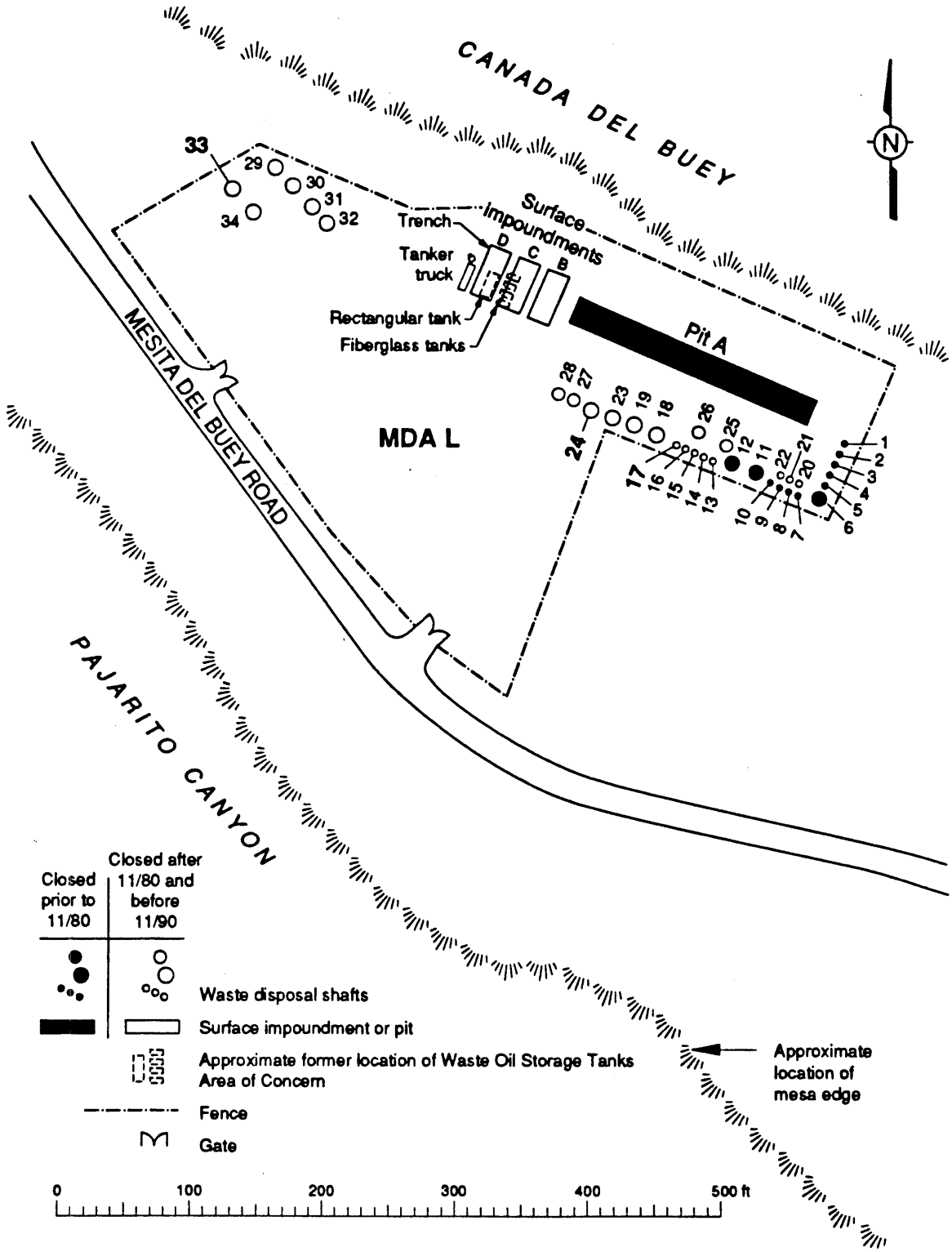


Figure 5.3-2 Location map of inactive pits, shafts, impoundments (SWMU 54-006), and Waste Oil Storage Tank Area of Concern at MDA L. (Base map modified from IT Corp. 1987 and 1991.)

was started in 1972 but discontinued in 1984 for safety reasons. The unit was not used for disposal of any other hazardous wastes. After the treatment of lithium hydride was discontinued, the impoundment was used as secondary containment for used oil storage tanks. No logbooks were found regarding specific disposal information for Surface Impoundment D. Aerial photos indicate that Surface Impoundment D was closed between June 1987 and 1989.

Disposal Shafts

Thirty-four disposal shafts were drilled at MDA L between 1975 and 1985. They range in diameter from 3 ft to 8 ft and are each approximately 60 ft deep. The specific dates of operation for each shaft are listed in Table 5.3-2. When in use, the shafts were covered with a heavy steel cap, which could be opened or removed, depending on the design, to allow emplacement of waste. When filled, they were capped with a 3-ft-thick concrete plug.

The shafts were dry-drilled into the tuff with an auger. The bottom of each shaft was lined with 3 ft of crushed tuff to seal cracks and joints. A steel cap was then placed over the opening. Since 1982, the wastes were accumulated on site and packaged in drums until sufficient quantities had accumulated to facilitate subsequent emplacement. The drums were lowered by crane into the shaft through doors in the steel cap and arranged in layers of one drum in a 3-ft-diameter shaft, one drum in a 4-ft-diameter shaft, four to five drums in a 6-ft-diameter shaft, and six drums in an 8-ft-diameter shaft.

The space around the drums was filled with crushed tuff, and a 6 in layer of crushed tuff was placed between each layer of drums. The crushed tuff provided additional absorbent and lift for structural strength to prevent the crushing of drums in the bottom of the shafts. Prior to 1982, and including Shafts 1 through 22, liquids were disposed of in drums or other containers without adding absorbents, and smaller containers were frequently simply dropped into the shaft. Noncontainerized wastes were also disposed of in these shafts. From Shaft 23 on, absorbents were added to drums containing free liquid.

Soil vapor analyses reported in 1987 (IT Corporation 1987, 0327) revealed the presence of a VOC vapor plume in the subsurface beneath MDA L (see Figure 5.3-3). The extent and complete nature of the plume has not been determined. Appendix A of this Work Plan is a voluntary corrective action plan (VCAP) to remediate the plume.

5.3.1.2 Conceptual Exposure Model

5.3.1.2.1 Existing Information on Nature and Extent of Contamination

Source Term

Available information taken from MDA L disposal logbook records was summarized, tabulated, and evaluated for level of confidence and data usability. The data

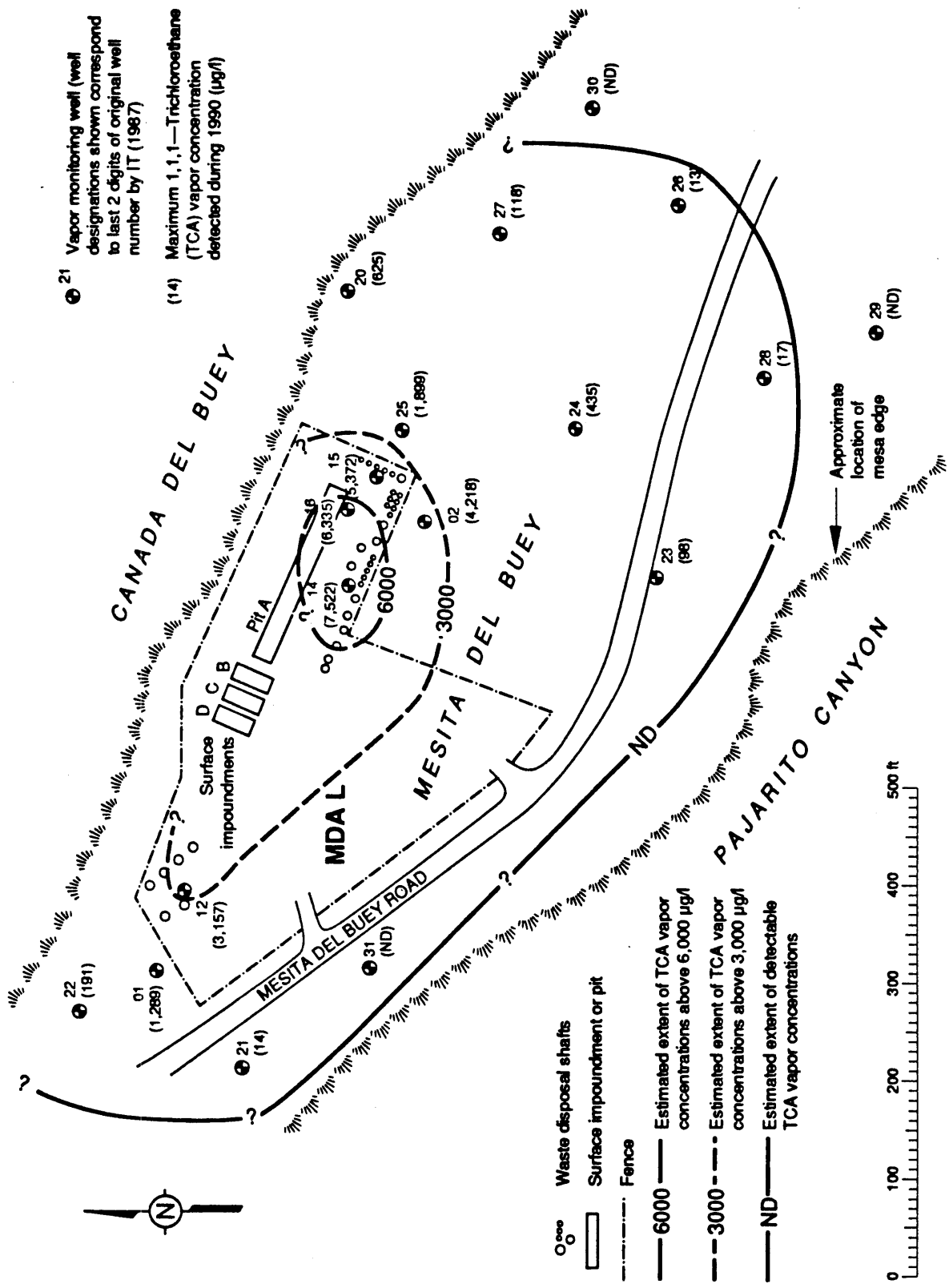


Figure 5.3-3 Approximate extent of vapor plume based on TCA distribution. (Base map modified from IT Corp. 1987 and 1991; well locations are approximate.)

evaluation and presentation processes were constructed so that the results could be used to support future migration pathway evaluation and modeling, and to develop a conceptual model that indicated whether the source term could be initially identified as an individual unit, a group of units, or whether all of the MDA L disposal units contributed equally as the source of the VOC plume present in the vadose zone within and surrounding MDA L. To this end, future ER Program efforts at MDA L may be narrowed, as appropriate, to address specific contaminant sources where they are identified.

Of the one pit, three surface impoundments, and 34 shafts located at MDA L, the source term data evaluation successfully identified five land disposal units with the greatest potential for plume source. They are Pit A, Surface Impoundment B, and Shafts 17, 24, and 33. The three shafts may contribute significant amounts of 1,1,1-trichloroethane to the VOC plume. Shafts 17, 24, and 33 are known to have received 11.77 ft^3, 44.10 ft^3, and 58.81 ft^3 of 1,1,1-trichloroethane, respectively. The sizes of Pit A and Surface Impoundment B and the records kept during the time the two units were open suggest that they received large volumes of heterogeneous waste. The two units are further implicated as a source of hazardous constituents due to batch-treated liquid waste discharged into Pit A and Surface Impoundment B, which may have facilitated downward migration of liquid contaminants along fractures within the tuff.

The wastes disposed of in MDA L were categorized into three waste categories: organic materials, inorganic materials, and unknown materials (i.e., materials that could not reliably be classified as either organic or inorganic). Each of these categories was used to evaluate the specified and unspecified amounts of wastes disposed of per year and per land disposal unit. Tables 5.3-3, 5.3-4, 5.3-5, and 5.3-6 summarize the specified and unspecified source term amounts using these categories. Known amounts, in either volume or weight, are from logbook entries that specify the disposal of material into a unique land disposal unit. Specified amounts are from logbook entries that do not specify the disposal of material into a unique land disposal unit. Total specified volumes for organic materials, inorganic materials, and unclassifiable materials were 5,446.78 ft^3, 2,072.40 ft^3, and 1,202.28 ft^3, respectively. Total unspecified volumes for organic materials, inorganic materials, and unclassifiable materials were 6,831.89 ft^3, 4,357.61 ft^3, and 4,475.87 ft^3, respectively. The largest unspecified volumes of organic materials were disposed of in calendar years 1977, 1979, 1983, and 1984. Shafts 1, 3, 4, 8, 9, 11, 12, 13, 14, 15, 16, 18, and 34 were filled to less than 10% of their capacity with specified volumes of materials. Pit A and Surface Impoundment B were filled to 10.4% and 24.6% of their respective capacities with specified volumes of materials.

Overall, the quality of the disposal records was poor in that the specific identity and final disposition of much of the waste were uncertain. For example, the records usually reported "organics" instead of a specific name such as "benzene," and a significant amount of material disposed (15,665 ft^3) was not assigned to specific land disposal units. Of this amount, greater than 6,500 ft^3 was potentially organic liquid; about 1,680 ft^3 was potentially inorganic liquid; and at least 53 ft^3 was 1,1,1-trichloroethane. Greater than 9,500 ft^3 of waste was unclassifiable because of the incomplete descriptions given in the logbook entries. Of the 1,995 total records in the MDA L source term data base [Appendices 3-D, 3-E, and 3-F of the Operable Unit 1148 Data Report (IT Corporation 1992, 08-0015)], only 369 were complete. No

TABLE 5.3-3
SPECIFIED[a] AND UNSPECIFIED[b] VOLUMES (ft³) OF MATERIALS DISPOSED OF AT TA-54, MDA L, PER YEAR[c]

Year	Total Volume (ft³) of Materials Disposed	Specified Volume (ft³) of Unclassifiable[d] Waste Disposed	Unspecified Volume (ft³) of Unclassifiable Wasted Disposed	Specified Volume (ft³) of Organics Disposed	Unspecified Volume (ft³) of Organics Disposed	Specified Volume (ft³) of Inorganics Disposed	Unspecified Volume (ft³) of Inorganics Disposed
1975	279.24	NR	63.00	NR	188.24	NR	28.00
1976	2014.62	517.14	748.00	251.96	363.85	129.67	4.00
1977	4575.81	248.59	1045.80	235.25	2004.49	647.06	394.62
1978	1015.00	28.50	762.00	9.00	91.00	2.00	122.50
1979	4525.13	NR	1056.50	10.00	2025.64	26.00	1406.99
1980	5041.40	71.71	760.19	274.69	1728.59	142.77	2063.45
1981	1121.11	52.86	10.77	497.74	222.34	321.53	15.87
1982	NR	NR	NR	NR	NR	NR	NR
1983	1554.28	41.58	NR	1288.85	NR	223.85	NR
1984	3309.04	157.19	NR	2493.74	1.00	429.88	227.22
1985	595.84	84.70	NR	385.55	NR	125.59	NR

[a]Specified volumes are sums from records that indicate disposal into a specific pit or shaft.
[b]Unspecified volumes are sums from records that did not indicate disposal into a specific pit or shaft.
[c]355.38 cubic ft³ of material was disposed of from records with no date.
[d]Waste that could not be classified as organic or inorganic.

NR Not Recorded

TABLE 5.3-4
SPECIFIED[a] AND UNSPECIFIED[b] WEIGHTS (lbs) OF MATERIALS DISPOSED OF AT TA-54, MDA L, PER YEAR[c]

Year	Total Weight (lbs) of Materials Disposed	Specified Weight (lbs) of Unclassifiable[d] Waste Disposed	Unspecified Weight (lbs) of Unclassifiable Waste Disposed	Specified Weight (lbs) of Organics Disposed	Unspecified Weight (lbs) of Organics Disposed	Specified Weight (lbs) of Inorganics Disposed	Unspecified Weight (lbs) of Inorganics Disposed
1975	1065.00	NR	65.00	NR	500.00	NR	500.00
1976	1.00	NR	NR	NR	NR	1.00	NR
1977	4.00	NR	NR	NR	NR	4.00	NR
1978	NR	NR	NR	NR	NR	NR	NR
1979	1249.25	NR	NR	NR	NR	NR	1249.25
1980	16400.60	5.28	0.00	NR	209.73	0.00	16185.59
1981	32.91	NR	NR	NR	NR	32.90	0.01
1982	NR	NR	NR	NR	NR	NR	NR
1983	NR	NR	NR	NR	NR	NR	NR
1984	0.36	NR	NR	NR	NR	NR	0.36
1985	NR	NR	NR	NR	NR	NR	NR

[a]Specified weights are sums from records that indicate disposal into a specific pit or shaft.
[b]Unspecified weights are sums from records that did not indicate disposal into a specific pit or shaft.
[c]555.00 ft³ of material was disposed of from records with no date.
[d]Waste that could not be classified as organic or inorganic.

NR Not recorded

TABLE 5.3-5
SPECIFIED[a] VOLUME (ft^3) OF MATERIALS DISPOSED OF AT TA-54, MDA L, PER DISPOSAL UNIT

Pit, Shaft, or Impoundment		Specified Volume (ft^3) of Materials Disposed	Specified Volume (ft^3) of Unclassifiable[b] Waste Disposed	Specified Volume (ft^3) of Organic Waste Disposed	Specified Volume (ft^3) of Inorganic Waste
Pit	A	300.84	168.44	48.00	84.40
Impoundment	B[c]	492.60	80.71	60.96	350.92
Impoundment	C[c]	NR	NR	NR	NR
Impoundment	D[c]	NR	NR	NR	NR
Shaft	1[c]	NR	NR	NR	NR
	2	304.04	28.50	35.00	240.54
	3	27.50	NR	NR	27.50
	4	1.00	NR	1.00	NR
	5	577.25	395.25	181.00	1.00
	6	199.12	8.04	58.96	132.12
	7	74.67	22.00	NR	52.67
	8	NR	NR	NR	NR
	9	40.50	2.00	1.00	37.50
	10	584.25	170.00	172.25	242.00
	11	9.00	NR	9.00	NR
	12	NR	NR	NR	NR
	13[c]	105.38	2.67	NR	102.71
	14[c]	NR	NR	NR	NR
	15[c]	18.10	NR	NR	18.10
	16[c]	4.90	NR	0.25	4.65
	17[c]	393.03	45.00	326.32	21.71
	18[c]	NR	NR	NR	NR
	19[c]	406.19	20.60	385.59	NR
	20[c]	84.15	NR	52.61	31.54
	21[c]	70.38	48.49	NR	21.89
	22[c]	200.18	8.12	192.06	NR
	23[c]	523.20	NR	523.20	NR
	24[c]	731.21	NR	731.21	NR
	25[c]	485.78	29.41	NR	456.37
	26[c]	490.34	NR	437.56	52.78
	27[c]	171.15	18.71	11.05	141.39
	28[c]	192.93	22.03	170.40	0.50
	29[c]	591.06	58.83	517.55	14.68
	30[c]	669.67	14.69	654.98	NR
	31[c]	269.27	NR	269.27	NR
	32[c]	58.83	NR	58.83	NR
	33[c]	475.27	36.76	438.51	NR
	34[c]	169.68	22.03	110.22	37.43

[a] Specified volumes are sums from records that indicate disposal into a specific pit or shaft.
[b] Wastes that could not be classified as organic or inorganic.
[c] Impoundments and shafts subject to closure authority of NMED.
NR Not Recorded

TABLE 5.3-6
SPECIFIED[a] WEIGHT (lbs) OF MATERIALS DISPOSED OF AT TA-54, MDA L, PER DISPOSAL UNIT

Pit, Shaft, or Impoundment		Specified Weight (lbs of Materials Disposed	Specified Weight (lbs) of Unclassifiable[b] Waste Disposed	Specified Weight (lbs) or Organic Waste Disposed	Specified Weight (lbs) of Inorganic Waste Disposed
Pit	A	NR	NR	NR	NR
Impoundment	B[c]	27.50	NR	NR	27.50
Impoundment	C[c]	NR	NR	NR	NR
Impoundment	D[c]	NR	NR	NR	NR
Shaft	1[c]	NR	NR	NR	NR
	2	NR	NR	NR	NR
	3	NR	NR	NR	NR
	4	NR	NR	NR	NR
	5	NR	NR	NR	NR
	6	5.00	NR	NR	5.00
	7	NR	NR	NR	NR
	8	NR	NR	NR	NR
	9	NR	NR	NR	NR
	10	NR	NR	NR	NR
	11	NR	NR	NR	NR
	12	NR	NR	NR	NR
	13[c]	6.28	5.28	NR	1.00
	14[c]	NR	NR	NR	NR
	15[c]	NR	NR	NR	NR
	16[c]	NR	NR	NR	NR
	17[c]	NR	NR	NR	NR
	18[c]	NR	NR	NR	NR
	19[c]	4.40	NR	NR	4.40
	20[c]	NR	NR	NR	NR
	21[c]	NR	NR	NR	NR
	22[c]	NR	NR	NR	NR
	23[c]	NR	NR	NR	NR
	24[c]	NR	NR	NR	NR
	25[c]	NR	NR	NR	NR
	26[c]	NR	NR	NR	NR
	27[c]	NR	NR	NR	NR
	28[c]	NR	NR	NR	NR
	29[c]	NR	NR	NR	NR
	30[c]	NR	NR	NR	NR
	31[c]	NR	NR	NR	NR
	32[c]	NR	NR	NR	NR
	33[c]	NR	NR	NR	NR
	34[c]	NR	NR	NR	NR

[a] Specified weights are sums from records that indicate disposal into a specific pit or shaft.
[b] Wastes that could not be classified as organic or inorganic.
[c] Impoundments and shafts subject to closure authority of NMED.
NR Not Recorded

records were dated from 1982, and 67 records had no date. Although Surface Impoundments C and D were apparently used, there were no logbook entries indicating disposal of material into either of these land disposal units. Shafts 5 and 10, both of which had a maximum capacity of only 424 ft^3, allegedly received 577.25 ft^3 and 584.25 ft^3 of waste material, respectively.

Batch Treatment

Of the above disposal units identified as being the most likely candidates for remediation, a source for enhanced downward migration was identified for Pit A and Surface Impoundment B through a data base built from entries into a batch-waste logbook [Appendices 3-G, 3-H, and 3-I in the Operational Unit 1148 Data Report (IT Corporation 1991, 08-0015)]. The logbook documents that a relatively large volume (over 7,500 ft^3) of liquid waste was generated from 1974 to 1984. Based on standard operating procedures in effect during that time frame, the majority of the waste from these batch-treatment processes was disposed of in evaporation pits/surface impoundments at MDA L. Pit A and Surface Impoundment B were identified by MDA L personnel (IT Corporation 1991, 08-0015) as being open and receiving waste at the time. Pit A was used for disposal from the late 1950s through 1978. Surface Impoundment B was opened in 1979 and remained open through June 1985.

Bulk quantities of treated aqueous waste were discharged into the pit or surface impoundment, where they pooled and were left to evaporate. After the water evaporated, a salt cake was left in the bottom of the pit/surface impoundment. When a salt cake reached 1 yd from the top of the pit or surface impoundment, it was backfilled. The amount of aqueous waste that evaporated after disposal into the pit or surface impoundment and the amount that migrated downward into the subsurface along fractures in the tuff is unknown.

Four processes are identified as major contributors to the batch-treatment waste stream. They are treatments for ammonium bifluoride; acids, bases, and heavy metals; cyanide solutions; and chromium waste. Each process is briefly described as follows:

Ammonium bifluoride waste was neutralized by adding calcium chloride and calcium hydroxide. Ammonium chloride, calcium fluoride, and water resulted from the process. End products were disposed of at MDA L.

Acids and caustics in quantities less than 55 gal were disposed of in designated shafts at MDA L without undergoing a dilution/neutralization process. Larger quantities were diluted to 15% or less and neutralized. Acid solutions were neutralized with sodium hydroxide. Base solutions were neutralized with mineral acids. Heavy metals were precipitated and removed prior to disposal. End products were disposed of at MDA L.

Cyanide solutions were treated with calcium hypochlorite, producing cyanate, and, upon completion, produced carbon dioxide and nitrogen. An alternate treatment for cyanide solutions used chlorine gas and sodium hydroxide, which creates the same effect (ESG 1976, 08-0047). Cyanide concentrations were treated to <10,000 ppm. After treatment, the solution was disposed of in an evaporation Pit at MDA L. Sludge from the process was placed in metal drums and mixed with cement. These drums

were buried at MDA L. Although past practices treated cyanide solutions to <10,000 ppm, it is important to note that current practices require concentrations to fall below 0.1 ppm.

Chromium waste was treated with sulfur dioxide and sodium hydroxide, resulting in sodium sulfate and chromium hydroxide. An alternate chromium waste treatment process included sodium bisulfite as an alternative to sulfur dioxide as a reducing agent prior to precipitating the chromium from solution. The waste solution was disposed of at MDA L (ESG 1976, 08-0047).

Two important points regarding the volume, concentration, and effect of the batch-treated waste disposed of at MDA L should be made with respect to contaminant plume source and migration.

First, the data base created from the batch-waste logbook provides an estimate of the minimum volume of batch waste disposed of in Pit A and Surface Impoundment B. The logbook represents a distinct time period from 1974 to 1984. Waste volumes entered into the logbook are assumed to describe waste volumes prior to undergoing the batch-treatment process. Because batch-treatment often required dilution, the total volume of batch-treated aqueous waste may have been two or more times the total volume (> 7,500 ft^3) reflected in the logbook and summarized in the batch-waste data base [Appendices 3-G, 3-H, and 3-I of the Operable Unit 1148 Data Report (IT Corporation 1992, 08-0015)]. For this reason, the large volume of batch-treated liquid waste disposed of in Pit A and Surface Impoundment B may have resulted in downward migration of liquid contaminants along fractures within the tuff.

Second, most waste listed in the logbook was treated prior to disposal, although a small quantity may have been disposed of without prior treatment. For this reason, the major effect of the batch-treated waste with respect to contaminant plume source and migration is considered to be derived from its volume and subsequent effect on potentiometric head, rather than from a concentration of any specific hazardous constituent.

Historical Releases

Little information regarding the historical releases of hazardous constituents at MDA L is available in Laboratory documents. Thus, the information for this report came from interviews conducted by International Technology (IT) Corporation with long-time Laboratory employees. These interviewees remembered several unusual events at MDA L, but they did not remember exact dates.

1970 - 1979

An aqueous slurry of treated, neutralized ammonium bifluoride reacted with approximately 60 two-inch tubes containing sodium metal that had previously been disposed of in the surface impoundment at MDA L.

The contents of several compressed-gas cylinders disposed of in Pit A were intentionally released. It was common in the early 1970s to pour chemicals into Pit A (IT Corporation 1991, 08-0029).

Bottles of acids and bases were thrown into Disposal Shaft 2 at MDA L and broken. Acids or bases were contained in the shaft to neutralize the resulting solutions. Reactions were frequently noted and fumes were released to the atmosphere. Dirt was occasionally added to the shaft to cover the reagents (IT Corporation 1991, 08-0027). The shaft was in operation from February 1975 to July 1979 (IT Corporation 1987, 0327).

1980 -1989

Three slightly different treatments for waste lithium hydride were evaluated at MDA L over a three-month period. First, approximately 50 lbs of the waste were placed in the surface impoundment and drowned in water. The only apparent reaction was fuming and fizzing. Next, a 250-gal tank was filled with water and 2 lbs of lithium hydride were dropped in. Finally, the lithium hydride was sprayed with water from a pump fitted with a nozzle.

On one occasion, sodium metal was thrown into the surface impoundment and allowed to react. At another time, about half a pint of picric acid was thrown into the impoundment (IT Corporation 1991, 08-0027). Reactive metals were usually put into one of the shafts designated for reactives.

In one instance, a 55-gal drum containing solvents, probably 1,1,1-trichloroethane, was opened and allowed to evaporate (IT Corporation 1991, 08-0027).

A compressed-gas cylinder containing hydrogen fluoride had been stored along the fence in MDA L for about two years. Assuming it to have been leaking for some time, Laboratory guards shot this cylinder, along with approximately 50 other cylinders containing primarily inert or noncombustible gases to liberate the contents (IT Corporation 1991, 08-0027). The practice of shooting gas cylinders was discontinued in 1988 (IT Corporation 1991, 08-0028).

A worker poured Hydrazine into a drum containing organics in 1986, which resulted in a violent reaction (IT Corporation 1991, 08-0028).

While a drum was being loaded onto a truck on October 25, 1988, 20 gal of dioxane spilled. An absorbent used to contain the spill to a 30 ft^2 area was containerized and stored at MDA L. The liquid portion of the spill was removed immediately by the Laboratory's Waste Management Group (EM-7). The liquid also contained 12% acetone and 21% alcohols (ESG 1988, 0408).

1990 - Present

A sanitary holding tank (TA-54-80) overflowed on December 8, 1990. The release traveled approximately 60 ft downgradient across an asphalt drive, but was contained on site and did not reach any watercourse. The discharged waste water on the asphalt drive evaporated (Environmental Protection Group 1990, 0497).

The 1989 Laboratory Environmental Surveillance Report presented the analytical results of sediment samples collected at nine locations north, south, and east of TA-54/51 (Environmental Protection Group 1990, 0497). The analyses for 2-Butanone, chloroform, toluene, and M-xylene range the limit of quantification (LOQ) to three

times the LOQ. Benzoic acid and Bis-(2-ethylhexyl) phthalate were detected above the LOQ. PCBs, herbicides, and pesticides were below the LOQ.

Vadose zone monitoring wells were installed in response to the NMED Compliance Order for a ground-water monitoring waiver at MDA L. Sample results indicate that 1,1,1-trichloroethane is the dominant soil vapor constituent present in MDAs G and L. Less abundant compounds include trichlorethylene, perchloroethylene, chloroform, toluene, and Freon. A review of the results has led to the following general conclusions:

- The details of the wells and analyses are presented in the voluntary corrective action plan (VCAP) presented in Appendix A of this document.
- Soil vapor contamination exists to a depth of at least 200 ft below grade.
- Temporal trends in TCA common to all wells were not observed.
- A potential decrease in concentration with time exists in multiple sample intervals, but the trend is not consistent for the entire area.
- Seasonal variations in concentration can not be determined from existing data.

In summary, there have been releases from the closed subsurface disposal sites, as evidenced by the presence of VOCs in samples collected from vapor monitoring wells remote from the closed pits and shafts.

5.3.1.2.2 Potential Pathways of Contaminant Migration

Three potential pathways of concern have been identified for MDA L if containment of the hazardous materials or hazardous waste is lost. They are:

- airborne transport of dust, gas, or vapor;
- surface water runoff with sediment transport; and
- vapor movement through the vadose zone to the main aquifer.

MDA L is a RCRA-permitted TSD facility under institutional control for an indefinite period. Although workers at MDA L may be exposed to hazardous or mixed waste because of loss of containment during treatment or storage, or because of loss of containment of previously stored waste, worker exposure is not considered in this Work Plan as such exposure falls under the purview of a RCRA-permit contingency plan and is not within the scope of the ER Program.

Similarly, because of continued institutional control, erosive exposure of subsurface contamination (because of mass wasting of the canyon walls) is not considered an environmental pathway. Evidence of such exposure would be noted during routine inspections conducted in compliance with RCRA-permit requirements and would be mitigated at that time through engineering controls.

Potential pathways are summarized in Figure 5.3-4 and are discussed in greater detail in the following sections.

Atmospheric Dispersion Pathway

Release mechanisms for the air pathway include wind entrainment of contaminated soil (resuspension) and releases of volatile compounds from within the soil profile. Wind speed, direction, and stability class plus vegetative cover, soil physical properties, soil moisture content, and soil heat flux are important variables affecting resuspension and soil gas releases (Travis 1975, 0420; Abeele and Nyhan 1987, 0008). The predominant wind direction for TA-54 is from the south-southwest, up the Rio Grande Valley. A more westerly, downslope component from the Jemez Mountains is common at night. This information implies that the deposition patterns for the wind-borne contaminants should be most prominent to the north-northeast of TA-54, although downslope deposition patterns cannot be neglected.

Exposures from this pathway would occur through inhalation, ingestion, or dermal contact. VOCs or SVOCs could be released by evapotranspiration, which could result in inhalation exposures of receptors. Atmospheric dispersion is the most likely avenue for human exposure to the contaminants at MDA L.

Surface Water Runoff Pathway

The climate of the OU is discussed in Section 3 of this Work Plan. The climatic factors at MDA L often result in significant surface water runoff and soil erosion. The release mechanism for the runoff pathway is erosion of contaminated surface soils. The environmental dispersal of contaminants by the runoff pathway has three major components, as follows:

- contamination of sediments in the primary drainage channel from the MDA;
- contamination of surface water from the dissolved and suspended solids; and
- contamination of the shallow alluvium in the canyon bottom. An alluvial aquifer has not been observed in Cañada del Buey.

The runoff could carry dissolved constituents or contaminated sediments from the mesa to the canyons. Volatile compounds could be released upon evaporation, and solid residues could be resuspended and transported by the air pathway as described above. Heavy surface water runoff is most likely during the high-intensity thunderstorms that occur in the summer.

Infiltration and Vadose Zone Transport

At MDA L, migration of contaminants in the subsurface will be in unsaturated rock of the Bandelier Tuff. Three mechanisms are of importance in the vadose zone. They are:

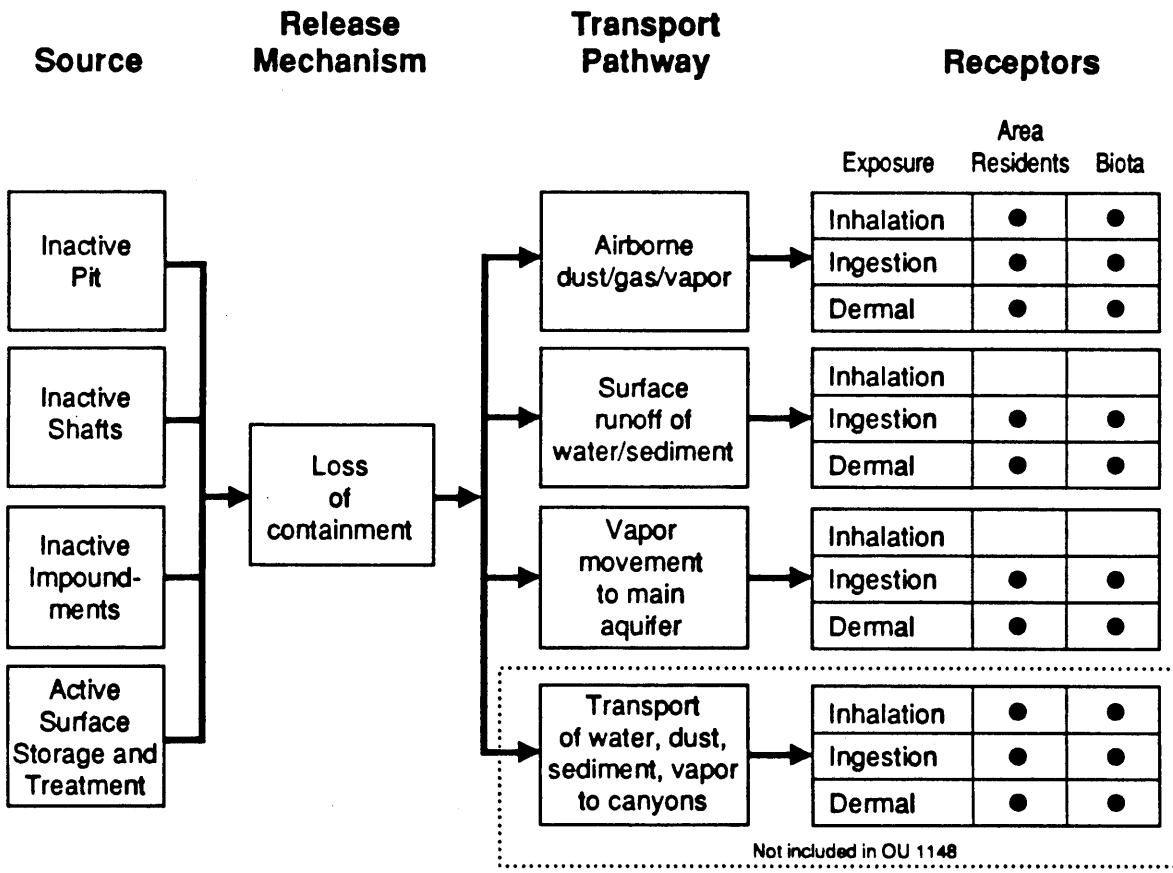


Figure 5.3-4 Conceptual model for MDA L.

- infiltration of precipitation, which can provide the water to serve as a contaminant-carrying transport media;
- movement of the contaminant-bearing water in the vadose zone via unsaturated flow processes; and
- movement of tritiated water vapor and vapors of volatile compounds through the vadose zone in the gas phase.

At MDA L, the potentiometric surface of the main aquifer lies at about 5,680 to 5,880 ft above sea level (asl). More than 900 to 1,000 ft of unsaturated tuff and volcanic rock separate the mesa top from the aquifer. There is little potential for downward flow of liquids from the surface to the main aquifer because of the low moisture conditions of the tuff and the high evapotranspiration rates.

Liquid Migration

The existing studies support the assessment that liquid-phase migration in the vadose zone is not a pathway in the Bandelier Tuff (IT Corporation 1987, 0327). Migration into the tuff may have occurred during the time when significant volumes of disposed liquids were released; however, liquid-phase migration ceased soon after the liquid releases ceased and cannot occur again unless a significant amount of water is added. The studies also indicated that infiltration of natural precipitation cannot provide the necessary quantities of water.

Transport to surface water or perched water in Pajarito Canyon is unlikely because MDA L drains into Cañada del Buey. Uncertainties remain regarding the role and importance of joints and fractures in the tuff, which could act as enhanced routes for precipitation infiltration, and the presence and importance of impermeable zones within the tuff (perhaps at unit contacts) in which liquids input to the tuff may have perched and may potentially move horizontally to a release point along a canyon wall. Perched water, however, has not been encountered to date in the Bandelier Tuff (IT Corporation 1987, 0327).

Vapor Migration

The major exposure mode for off-site receptors is dispersal of constituents through air transport of dusts or vapors, including contaminated water vapor from evapotranspiration of rain or snow. Windblown dust or vapor from the mesa could reach Pajarito Canyon, with dissolution and percolation of constituents into alluvial perched water in that canyon. Cañada del Buey can receive such contaminants, but this canyon does not contain perched water (IT Corporation 1987, 0327).

There is a significant VOC vapor plume in the subsurface beneath MDA L (see Figure 5.3-3). The nature and extent of the plume is not completely known at this time. VOC contaminants are known to be present to a depth of 200 ft below the MDA. The plume is not currently a threat to the main aquifer, which is separated from the mesa top by 900 to 1,000 ft of unsaturated tuff and volcanic rock (IT Corporation 1987, 0327). Appendix A presents a VCAP to remediate the plume to prevent the possibility of contaminants reaching the main aquifer in the future. Available information on the nature and extent of the VOC plume is presented in Appendix A.

5.3.1.2.3 Potential Public Health and Environmental Impacts

Identification of Potential Receptors

The identification of populations representing potential receptors for contaminants released at MDA L is based on the pathways described in Section 5.3.1.2.2. Several subjects are addressed in this section including :

- local human populations,
- present and future land use patterns,
- potential exposure routes, and
- pathway-specific receptors.

This section presents available information and identifies additional data needed for assessing threats to human health or the environment. The data needs identified will be acquired during the RFI. In future activities, these data will be used to assess the need for interim corrective measures, to perform baseline risk assessments for evaluation of no-action alternatives, and to evaluate the relative benefits of competing remedial alternatives.

Local Populations

The Laboratory's Installation Work Plan (IWP) (LANL 1991, 0553) describes the population distribution within a 50-mile radius of the Laboratory. The closest communities to MDA L are White Rock and Los Alamos.

The intersection of Pajarito Road and State Road 4, which borders the northwest side of White Rock, is 2.0 mi from MDA L. The nearest Los Alamos residential area is a trailer park 3.7 mi from MDA L.

Land Use

MDA L is an active RCRA-permitted facility for the treatment and storage of hazardous waste. MDA L will be held under institutional control to meet conditional remedy requirements of RCRA Subpart S. The MDA is located within OU 1148 and all land within the OU is the property of DOE. Access by the general public to the OU is restricted. A future land use scenario for OU 1148 is transfer of ownership to Bandelier National Monument. Under this scenario, institutional control would be maintained for MDA L, but the land surrounding the MDA would be available for recreational use.

Routes of Exposure

The pathways of concern for MDA L are subsurface migration of volatile contaminants, surface water runoff, and atmospheric dispersion (see Figure 5.3-4). For each potential pathway identified in Section 5.3.1.2.2, routes of exposure for potential receptors have been identified. For airborne contaminants, inhalation and subsequent ingestion and dermal contact have been identified. For contaminated soil surfaces, ingestion has been cited as the potential route of exposure to account

for accidental ingestion of soil by adults and the often intentional ingestion by children. Ingestion of water is listed as a potential exposure route for surface water, although the potential for such ingestion is considered small. Ingestion is also a possible exposure route for the alluvial aquifers although, again, little potential exists. There is little potential for human exposure from contaminants held in deep rock. Plants can access only shallow contamination (e.g., in surface water runoff pathways).

Pathway-Specific Receptors

For each potential contaminant pathway and route of exposure, potential receptors are identified in the conceptual model, presented in Figure 5.3-4. Area residents may be exposed to airborne contaminants and contaminated surface soils, although the potential is extremely low. Human receptors exposed to surface water runoff and drainage sediments are limited to those living downstream and to persons hiking along the drainages. There is a limited data set indicating the presence of VOCs in sediment samples in both canyons (Environmental Protection Group 1990, 0497). Contamination within the canyons will be addressed in another OU work plan. Human receptors could not be identified for the ground water in the alluvial aquifer in Pajarito Canyon, nor for contaminants retained in the liquid or vapor phase in subsurface rock and soil. A remote potential exists for human ingestion of contaminated water from seeps or springs. This route would be limited to persons hiking along a drainage.

Biota are also identified as potential receptors. Terrestrial biota are predominant because of the climate and the ephemeral nature of flow in the drainages. Deep-rooted flora are the only potential receptors for contaminants in subsurface soil and rock. Small mammals, birds, reptiles, and insects are common terrestrial fauna throughout the area near MDA L.

Should loss of containment occur in the storage pits, shafts, or surface impoundments at MDA L, area residents and visitors may be exposed to gas/vapor emissions, contaminated water in the form of rain or snow, or contaminated soil either by wind-borne dust emissions, direct contact, or surface water runoff transport to the canyons. Loss of containment that will result in a release to a receptor is not expected to occur because of long-term institutional control.

5.3.2 Remediation Alternatives and Evaluation Criteria

The decision analysis approach, which provides for efficient identification and evaluation of corrective measures alternatives, is described in Appendix I of the IWP. Because the decision analysis process is being developed concurrently with this Work Plan, the process will be applied to this OU during the first year of field work, reflecting the decision-making framework described in the IWP. Future documents describing work at the OU will also reflect this approach.

5.3.3 Data Needs and Data Quality Objectives

5.3.3.1 Health and Safety Risks

5.3.3.1.1 Source Characterization

Documentation describing waste disposal in MDA L pits, surface impoundments, and shafts is incomplete. Waste segregation based on chemical compatibility improved after 1980. Until that time, hazardous wastes were frequently disposed of together in the same unit. Based on pore-gas sampling conducted from the mid-1980s to the present, there has been a release of VOCs in MDA L; however, the spatial and temporal extent of that release is unknown. A more complete understanding of the source term will be required to determine the nature of a remediation effort.

Satisfaction of the data needs presented in Section 1.4 and summarized in Table 5.3-7 will provide a better understanding of the nature of the source term and the vertical and horizontal extent of the VOC plume in the vadose zone. Data acquired from a two-phase sampling approach will be used as input to modeling for the VCAP and for the MDA L closure plan modification.

5.3.3.1.2 Environmental Setting

The data needs for the potential pathways shown in the conceptual model (Figure 5.3-4) are presented in Table 5.3-8. These data needs are for both pathways characterization and for inputs to risk assessment. These needs will be addressed within the defined institutional control area, at its boundary, and slightly beyond its boundary. Sampling beyond the institutional control point will still be within the OU. There will be no collection of data within the adjacent OUs (i.e., the canyons).

5.3.3.1.3 Potential Receptors

The identification of potential receptors for contaminants released from MDA L is based on the pathways described previously and includes human populations (area residents and visitors to the canyons) and biota. Section 5.3.1.2.3 provides specific information regarding the identification of potential receptors.

The data needs regarding potential receptors for MDA L potential releases is based on inputs into models for determining risk. The assessments will be health risk-based criteria for both human health and the environment. Table 5.3-9 lists the data needs for the receptor analysis.

5.3.3.2 MDA L Data Quality Objectives

The decision processes and data quality objectives (DQOs) described in this section are specific to MDA L SWMUs. The subsection format follows the more general process described in detail in Section 1.4. The reader is referred to Section 1.4 for

TABLE 5.3-7
INFORMATION NEEDED FOR PHASE I SOURCE CHARACTERIZATION OF MDA L DISPOSAL UNITS[a]

1.	Constituent Concentration in Media
	EPA-Protocol Volatile Organic Compounds (VOCs)
	EPA-Protocol Semivolatile Organic Compounds (SVOCs)
	EPA-Protocol Metals
	Pesticides
	PCBs
	Reactive Cyanide
	Tritium
	Gross alpha, gross beta, and gamma emitters
2.	Media
	Surface Water
	Soils/sediments
	Air

aThese constituents and associated analytical methods are given in the Laboratory's IWP (LANL 1991, 0553).

TABLE 5.3-8
INFORMATION NEEDED FOR PHASE I TRANSPORT PATHWAY CHARACTERIZATION OF MDA L

1. Surface Water Runoff Pathway

   Monthly Rainfall Averages
   Drainage Patterns
   Background Concentrations of Each Constituent

2. Soils/Sediments Pathway

   Respirable Dust Fraction
   Erodability
   Organic Carbon Content
   Moisture Content
   Background Concentration of Each Constituent

3. Subsurface Migration Pathway

   Rock Mineralogy
   In Situ Air Permeability of Characteristic Rock Types
   Fracture Density
   Hydraulic Conductivity
   Background Concentration of Each Constituent

4. Air Pathway

   Wind Roses
   Wind Erosion Data
   Background Concentration of Each Constituent

TABLE 5.3-9
INFORMATION NEEDED FOR PHASE I POTENTIAL RECEPTOR CHARACTERIZATION ACCORDING TO MDA L CONCEPTUAL MODEL

1. General Land Use

   Local uses and possible future uses of MDA L:

   a. Active waste treatment and storage; inactive waste disposal
   b. Closure with continued institutional control

2. Human

   Human use of or access to MDA L and adjacent lands, including:

   a. Relationship between population centers and prevailing wind direction;
   b. Native American access to archeological sites under institutional control.
   c. Future access to land near MDA L for recreational use.

3. Demography

   A demographic profile of the people who use or have access to MDA L and adjacent land, including, but not limited to: age; sex; and sensitive subgroups. These receptor groups will be investigated if Phase II sampling is undertaken.

4. Biota

   A description of the biota on, adjacent to, or affected by MDA L. These receptor groups will be investigated if Phase II sampling is undertaken.

5. Ecology

   A description of the ecology overlying and adjacent to MDA L will be provided if Phase II sampling is undertaken.

6. Endangered/Threatened Species

   A description of any endangered or threatened species near MDA L.

7. Risk Assessment

   The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 version of the Installation Work Plan. This approach will be developed in adequate time for data analysis.

definitions of terms and decision criteria, and to Figure 1.4-1 for the decision flow chart.

5.3.3.2.1 MDA L Decision Process

Decision Point 1:

On the basis of existing information, is there any potential risk to human health or the environment from the subsurface disposal units at MDA L?

Yes. VOCs have been detected in vapor monitoring wells and the MDA was closed as a landfill.

Decision Point 2:

Is existing information sufficient to allow development of a Phase II sampling plan?

No. Existing information does not fully characterize the source term. Existing data are incomplete and in many cases are generic in nature. Therefore, Phase I SAPs will be executed at MDA L. As quantitative data become available, Phase I SAPs will be revised as appropriate. Data acquired in the Phase I investigation will serve as input to the next decision (Figure 1.4-1).

Decision Point 3:

Do the data collected in Phase I sampling confirm the presence of COCs at MDA L?

This question is addressed by the DQO process for MDA L. The DQOs for Phase I SAPs follow the format of Section 1.4.3.1, and the diagram shown on Figure 1.4-2.

Problem Statement

Constituents of concern are known to be present in subsurface disposal units, but data on concentrations and specific locations are not sufficient to allow design for an effective Phase II sampling plan.

Questions To Be Answered

Are the concentrations of constituents of concern in air, water, soils, sediments, or the subsurface above background levels, or above health risk-based action levels?

Decision Inputs/Data Needs for MDA L

Constituents of concern (COCs) for MDA L are summarized in Table 5.3-10. Those constituents designated as VOCs, SVOCs, and metals are specified in the Generic QAPjP (LANL 1991, 0412), and action levels for many of the constituents are available in Proposed RCRA Subpart S.

TABLE 5.3-10
CONSTITUENTS OF CONCERN ADDRESSED IN ENVIRONMENTAL TRANSPORT MEDIA AT MDA L

Transport Media	Constituents of Concern[a]	Phase I SAP (Section Number)
Surface Water	SW-846[b] VOCs[c], SVOCs[d], metals, pesticides, PCBs[e], cyanide, tritium, gross alpha, gross beta, gamma radioactivity	5.3.4.1
Surface Sediment	See above	5.3.4.2
Underground Soils (Cores)	See above	5.3.4.3
Subsurface Vapor	EPA-Protocol VOCs	5.3.4.4 5.3.4.5
Air Particulates	See Surface Water	5.3.4.6

[a] Specific compounds are listed in the indicated SAP
[b] EPA 1983, 0288 for water
EPA 1987, 0518 for sediment and soil
[c] Volatile Organic Compounds
[d] Semivolatile Organic Compounds
[e] Polychlorinated biphenyls

No suite of radionuclides of concern (ROCs) is specified in Proposed RCRA Subpart S. Existing information on the MDA L waste inventory was reviewed, and tritium was the only radionuclide identified. However, some waste that might contain other radionuclides was deposited at MDA L. Thus, the Phase I sampling plans include measurements of gross alpha and gross beta radioactivity as well as gamma emitters in samples.

The Phase I SAPs were developed to determine the COC concentration in each environmental transport medium in the conceptual model (Figure 5.3-4). The COCs to be sampled for in each transport medium of the Phase I SAPs are summarized in Table 5.3-10.

Decision Domain

The spatial domain includes all of TA-54, MDA L, and excludes the adjacent canyons, which are addressed in OU 1049. The Laboratory will maintain institutional control at MDA L as discussed in Section 1.0.

Decision Rule/Logic Statement

MDA L will ultimately be closed with long-term stabilization and monitoring. Because historic releases have occurred at MDA L and some COCs have been reported (Section 5.2.1.2), the Phase I plans discussed below have been designed to not only confirm the presence or absence of suspected COCs, but to provide initial data to transport models and to future health-risk assessments. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 version of the IWP. This approach will be developed in adequate time for data analysis. The results of the Phase I SAPs for MDA L will be used to validate transport models, to provide initial health-risk estimates, and to develop more comprehensive Phase II SAPs.

Acceptable Uncertainty Limits

Because MDA L site and waste characterization data are lacking, it is not possible to determine true risk ranges and tolerance limits. The characterization data needed to develop Phase II SAPs and perform health-risk assessments will be determined using the results of Phase I sampling and the risk assessment approach to be outlined in the 1992 IWP.

5.3.3.2.2 Approach to DQO Process

The Phase I sampling plans will rely on four levels of analytical data to allow determination of precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters. The results of this determination will guide the development of the Phase II sampling plans, if they are needed. The four levels of analytical data to be used during Phase I sampling activities are:

Level I Field screening to guide the selection of sampling locations for laboratory analyses;

Level II Field analysis to confirm Level I field screening results;

Level III Laboratory analyses for VOCs, SVOCs, metals, pesticides, PCBs, and cyanide; and

Level V Laboratory analyses at a laboratory with approved SOPs for tritium, gross alpha, gross beta, and gamma emitters.

The pathways of concern at MDA L include surface water runoff, surface sediment transport, atmospheric dispersion, and subsurface migration of contaminants. It is important to characterize these pathways to determine if COCs are absent or present. If COCs are present and are found to be migrating beyond the boundaries of institutional control, a health risk-based assessment will be performed to develop potential response actions to meet the requirements of conditional remedy under RCRA Subpart S.

The health risk-based assessment will rely heavily on the data acquired during the Phase I and Phase II sampling and analysis activities at MDA L. The use of Level III and Level V data, described above, provides the required degree of accuracy, precision, and defensibility of data that are needed to assess risk to human health and the environment.

5.3.3.2.3 Phase I Field Investigation

Phase I data collection at MDA L is intended to accomplish the following:

- by sampling air, surface water runoff, and surface sediment, determine if the COCs listed in Table 5.3-10 are present and migrating from the MDA and if so, determine if migration of COCs is likely to have adverse impacts to the public health or the environment;
- if present, identify the nature of subsurface contaminant plumes other than VOCs, by sampling boreholes; and
- assess the extent of the subsurface VOC plume and other contaminant plumes, if present, by sampling boreholes.

5.3.3.2.4 Phase II Field Investigation

Where necessary, a complete Phase II sampling plan will be implemented, following evaluation of the results of Phase I sampling and analysis. The Phase II sampling plans will be implemented to assess contaminant source and to further characterize the nature and extent of contamination so that appropriate response actions can be developed.

5.3.4 Sampling Plans

5.3.4.1 MDA L Surface Water Runoff Sampling

5.3.4.1.1 Sampling and Analysis Components

The purpose of collecting and analyzing surface water runoff samples from MDA L is to accumulate technically accurate and legally defensible data. The data will be used to determine the potential for off-site migration of radionuclides or hazardous waste constituents in the waterborne pathway. The data will be validated according to EPA functional guidelines for organic analysis (EPA 1988, 0293) and inorganic analysis (EPA 1988, 0296). Validation is necessary so that the data will be of such quality that they can be used in risk assessment calculations. Currently, there are no published EPA methods for validating all radionuclide analyses.

5.3.4.1.2 Sampling and Analysis Approach

This SAP is designed to obtain information on contaminant concentrations and contaminant transport in the environment around MDA L that will support DQO decisions. One of the primary transport mechanisms from MDA L is surface water runoff during heavy storms; therefore, sampling will take place in the primary runoff pathway at MDA L.

5.3.4.1.3 Primary Data Quality Factors

5.3.4.1.3.1 Prioritized Data Uses

The data to be collected are necessary for site characterization and risk assessment.

- Site Characterization - The existing data for MDA L do not include all of the regulated VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, gross alpha, gross beta, or gamma emitters. In addition, the existing data have not been validated. Additional data will be collected to meet data needs and to support the use of the existing data.

- Risk Assessment - The chemical source term for MDA L is not fully understood. It is not known whether the source will continue to generate vapors as buried containers lose integrity. The identities of the VOCs and their emanation fluxes are unknown at this time. Additional data will be collected to determine the nature and extent of the contaminants at MDA L. These data will be used in risk assessment calculations.

5.3.4.1.3.2 Appropriate Analytical Levels

Samples collected will be screened in the field and analyzed in a laboratory using EPA SW-846 (third edition) protocol. Photoionization Detectors (PIDs) and Flame Ionization Detectors (FIDs) will be used in the field to screen for organic vapors; and alpha, beta, and gamma survey instruments will be used for field screening ionizing radiation. The analytical levels include:

Level I Field Screen: PID/FID screen instruments; alpha, beta, gamma survey instruments,

Level II Field Analysis: Gas Chromatography (GC) with either a PID, FID, or Electron Capture Detector (ECD),

Level III SW-846 Laboratory Methods, and

Level V Radionuclide Analysis Laboratory Methods.

5.3.4.1.3.3 Primary Contaminants of Concern

The contaminants of concern at MDA L are VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, gross alpha, gross beta, and gamma emitters.

5.3.4.1.3.4 Levels of Concern

Appendix F of the IWP (LANL 1991, 0553) and 40 CFR 264, Proposed Subpart S, contain information on constituent levels of concern. Health risk-based determinations of levels of concern will be developed for constituents not listed in Appendix F. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 IWP. This approach will be developed in adequate time for data analysis.

5.3.4.1.3.5 Required Quantitation Limits

Quantitation limits for laboratory analysis of hazardous and radioactive constituents in water are given in Tables V.3 through V.9 of the Laboratory's Generic QAPjP (LANL 1991, 0412). Analytical methods used for surface water runoff samples at MDA L will fall in the range of these quantitation limits. The quantitation limits will be the current SW-846 protocol for VOCs, SVOCs, pesticides, PCBs, cyanide, and metals. Level V analysis for tritium, gross alpha, gross beta, and gamma emitters will use the current Laboratory-approved analytical contractor or EM-9.

5.3.4.1.3.6 Critical Samples

The water sample collected during a heavy storm is a critical sample because it represents potential transport beyond institutional control.

5.3.4.1.4 Rationale for Sampling Activity

The rationale for surface water runoff sampling from the drainage area is to:

- determine if VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, gross alpha, gross beta, and gamma emitters are being discharged from MDA L;
- further define source terms;
- collect data that can be used to support and supplement existing data for the DQO process; and
- collect data that can be used in a risk assessment.

5.3.4.1.5 Sampling Activity

One surface water runoff sample will be collected from the primary discharge point during Phase I sampling. The results will be compared to the Laboratory's Environmental Surveillance Program results (Environmental Protection Group 1990, 0497). The sampling location is shown on Figure 5.3-5. Table 5.3-11 summarizes the number of samples, the number of QC samples, and the analytical requirements for Phase I sampling. It also describes the types of required QC samples. Surface water runoff sampling procedures are presented in Section 1.0 of Appendix B.

5.3.4.1.6 Remaining SAP Elements

The remaining required elements of this SAP are common to all of the SAPs prepared for OU 1148. These common elements are listed in Table 5.3-12 and are located in Appendix B of this RFI Work Plan.

5.3.4.1.7 Phase II SAP

If Phase I sampling results indicate that COCs exceed health risk-based criteria, the source of the COCs may be the active treatment, storage, and volume reduction areas at MDA L. To determine if Phase I data are biased, judgmental sampling will be done by washing down the areas around the drum crusher, the mixed waste storage pad, and the waste oil storage area, and analyzing these three surface rinsate samples. Table 5.3-13 summarizes the number of samples and analytical requirements for the Phase II sampling activities.

5.3.4.1.8 Health and Safety

This SAP will follow the procedures outlined in the Laboratory's Environment, Safety and Health Manual (LANL 1990, 0335) and Annex III of this RFI Work Plan.

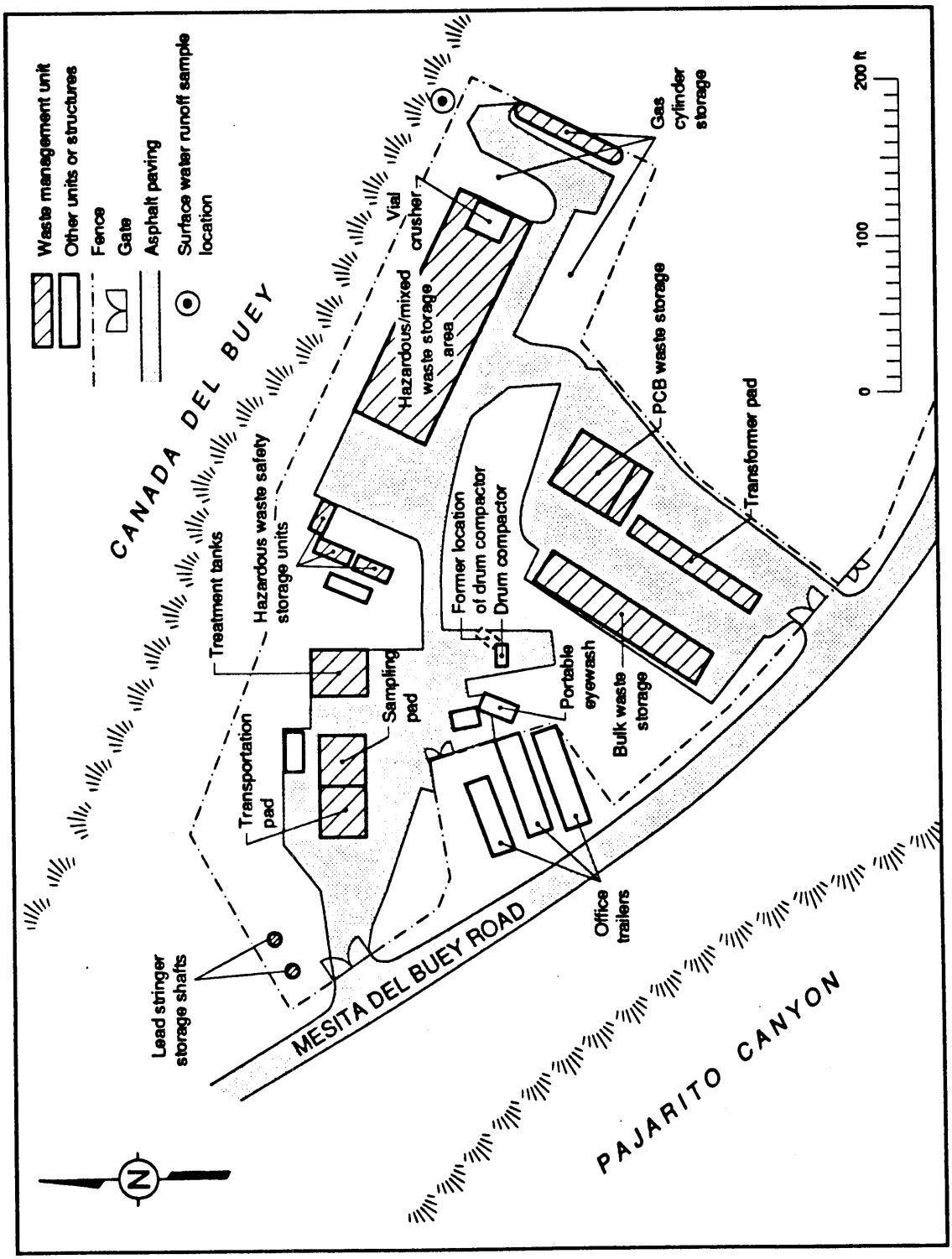


Figure 5.3-5 Surface water runoff sampling location at MDA L (base map modified from Benchmark Environmental Corp. 1990).

TABLE 5.3-11
PHASE I SAMPLING AND ANALYSIS PLAN TABLE FOR SURFACE WATER RUNOFF SAMPLING AT MDA L

Media	# of Samples	# of QC[a] Samples	Total Samples	Analysis
Water	1	4	5	VOCs SVOCs Metals Pesticides PCBs Cyanide Gross Alpha Gross Beta Gamma Spectroscopy

(a) Includes: Trip Blank, Field Blank, Duplicate Sample, and Equipment (Rinsate) Blank.

Trip Blank: Two 40 mL VOC sample containers filled with organic-free water at the Sample Coordination Facility. Filled trip blanks accompany sample bottles to the field, remain unopened throughout the sampling activity, and return with shipment only when sampling for VOCs.

Field Blank: Organic-free water is poured into sample containers at the sampling site.

Duplicate Samples: Collect two separate surface water runoff samples simultaneously.

Equipment (Rinsate) Blank: Obtained by running organic-free water over cleaned, decontaminated sampling equipment. Rinse the equipment surface that comes into contract with a sample.

TABLE 5.3-12
FIELD SAMPLING PLAN ELEMENTS LOCATED IN APPENDIX B

1. Sample Collection Procedures
2. Field Documentation
3. Sample Preservation and Handling Procedures
4. Field Quality Assurance
5. Variance Situation
6. Equipment List
7. Equipment Calibration
8. Decontamination Procedures
9. Precision, Accuracy, Representativeness, Completeness, and Comparability Review

TABLE 5.3-13
PHASE II SURFACE WATER RUNOFF (RINSATE) SAMPLING AT MDA L

Media	Phase II Sampling	Rationale	Analysis	# of Samples
Water	3 locations	Sample to characterize active sites.	COCs	3 + 4 QCs 7 Total

5.3.4.1.9 Schedule

See Annex I.

5.3.4.2 MDA L Surface Sediment Sampling

5.3.4.2.1 Sampling and Analysis Components

The purpose of collecting and analyzing surface sediment samples in the primary drainage pathway at MDA L is to accumulate technically accurate and legally defensible data. The data will be used to determine the potential for off-site migration of radionuclides or hazardous waste constituents in the sediment transport pathway. The data will be validated according to EPA functional guidelines for organic analysis (EPA 1988, 0293) and inorganic analysis (EPA 1988, 0296). Validation is necessary so that the quality of the data will be such that they can be used in risk assessment calculations. Currently, there are no published EPA methods for validating all radionuclide analyses.

5.3.4.2.2 Sampling and Analysis Approach

This SAP is designed to obtain information on contaminant concentrations and contaminant transport in the environment around MDA L that will support DQO decisions. One of the primary sediment transport mechanisms from TA-54 is surface water runoff; therefore, sediment sampling will take place in the primary runoff area at MDA L.

5.3.4.2.3 Primary Data Quality Factors

5.3.4.2.3.1 Prioritized Data Uses

The data to be collected are necessary for site characterization and risk assessment.

- Site Characterization - The existing data for MDA L do not include all of the regulated VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, and gross alpha, gross beta, and gamma emitters, and have not been validated. Additional data will be collected to meet the data needs and to support the use of existing data.

- Risk Assessment - The chemical source term for MDA L is not fully understood. It is not known whether the source will continue to generate vapors as the containers lose integrity. The identities of all of the VOCs and their emanation fluxes are unknown at this time. Additional data will be collected to determine the nature and extent of the contaminants at MDA L. These data will then be used in risk assessment calculations.

5.3.4.2.3.2 Appropriate Analytical Levels

Samples collected will be screened in the field and analyzed in a laboratory using EPA SW-846 (third edition) protocol. PIDs and FIDs will be used in the field to screen for organic vapors; and alpha, beta, and gamma survey instruments will be used for field screening ionizing radiation. The analytical levels include:

Level I Field Screen: PID/FID screen instruments; alpha, beta, gamma survey instruments,

Level II Field Analysis: GC with either a PID, FID, or ECD,

Level III SW-846 Laboratory Methods, and

Level V Radionuclide Analysis Laboratory Methods.

5.3.4.2.3.3 Primary Contaminants of Concern

The contaminants of concern at MDA L are VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, and gross alpha, gross beta, and gamma emitters.

5.3.4.2.3.4 Levels of Concern

Appendix F of the IWP (LANL 1991, 0553) and 40 CFR 264, Proposed Subpart S, contain information on constituent levels of concern. Health risk-based determinations of levels of concern will be developed for constituents not listed in Appendix F. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 IWP. This approach will be developed in adequate time for data analysis.

5.3.4.2.3.5 Required Quantitation Limits

Quantitation limits for laboratory analysis of hazardous and radioactive constituents in soil are given in Tables V.3 through V.9 of the Laboratory's Generic QAPjP (LANL 1991, 0412). Analytical methods used for surface sediment samples at MDA L will fall in the range of these quantitation limits. The quantitation limits will be the current SW-846 protocol for VOCs, SVOCs, metals, pesticides, PCBs, and cyanide. Level V analysis for tritium, gross alpha, gross beta, and gamma emitters will use the current Laboratory-approved analytical contractor or EM-9.

5.3.4.2.3.6 Critical Samples

Surface sediment samples collected in the primary drainage channel are critical samples because they represent potential transport beyond institutional control.

5.3.4.2.4 Rationale for Sampling Activity

The rationale for surface sediment sampling from the drainage area is to:

- determine if VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, gross alpha, gross beta, and gamma emitters are being discharged from MDA L;
- further define source terms;
- collect data that can be used to support and supplement existing data for the DQO process; and
- collect data that can be used in a risk assessment.

5.3.4.2.5 Sampling Activity

One set of nine surface sediment samples will be collected from the primary drainage channel during Phase I sampling. The results will be compared to the Laboratory's Environmental Surveillance Program results from surface sediment sampling in the adjacent canyons (Environmental Protection Group 1990, 0497). Table 5.3-14 summarizes the number of surface sediment samples, the number of QC samples, and the analytical requirements of the Phase I sampling. Surface sediment sampling procedures are presented in Section 2.0 of Appendix B.

Figure 5.3-6 shows the location of the drainage channel to be sampled. The channel has been divided into a 3- by 20-ft grid, and nine sample locations were randomly selected. The figure also shows the sample grid and the randomly selected sample points. The long, narrow grid was constructed to reflect the geomorphic drainage features.

5.3.4.2.6 Remaining SAP Elements

The remaining required elements of this SAP are common to all of the SAPs prepared for OU 1148. These common elements are listed in Table 5.3-12 and are located in Appendix B of this RFI Work Plan.

5.3.4.2.7 Phase II SAP

Phase II surface sediment sampling will be conducted at MDA L to determine the vertical and lateral extent of any COCs detected during Phase I sampling that exceeded health risk-based criteria. Samples will be collected from 6 to 12 in below the three locations that had the highest concentrations of COCs during Phase I sampling. In addition, samples will be collected from three locations within the talus slope just over the edge of the mesa and downslope from the Phase I sampling locations. Table 5.3-15 summarizes the Phase II sampling program.

TABLE 5.3-14
PHASE I SAMPLING AND ANALYSIS PLAN TABLE FOR SURFACE SEDIMENT SAMPLING AT MDA L

Media	# of Samples	# of QC[a] Samples	Total Samples	Analysis
Soil	9	4	13	VOCs SVOCs Metals Pesticides PCBs Cyanide Gross Alpha Gross Beta Gamma Spectroscopy

(a) Includes: Trip Blank, Field Blank, Duplicate Sample, and Equipment (Rinsate) Blank.

Trip Blank: Two 40 ml VOC sample containers filled with organic-free water at the Sample Coordination Facility. Filled trip blanks accompany sample bottles to the field, remain unopened throughout the sampling activity, and return with shipment to the analytical laboratory. Submitted only when sampling for VOCs.

Field Blank: Organic-free water is poured into sample containers at the sampling site.

Duplicate Sample: Collect two separate surface sediment samples simultaneously.

Equipment (Rinsate) Blank: Obtained by running organic-free water over cleaned, decontaminated sampling equipment. Rinse the equipment surface that comes into contact with a sample.

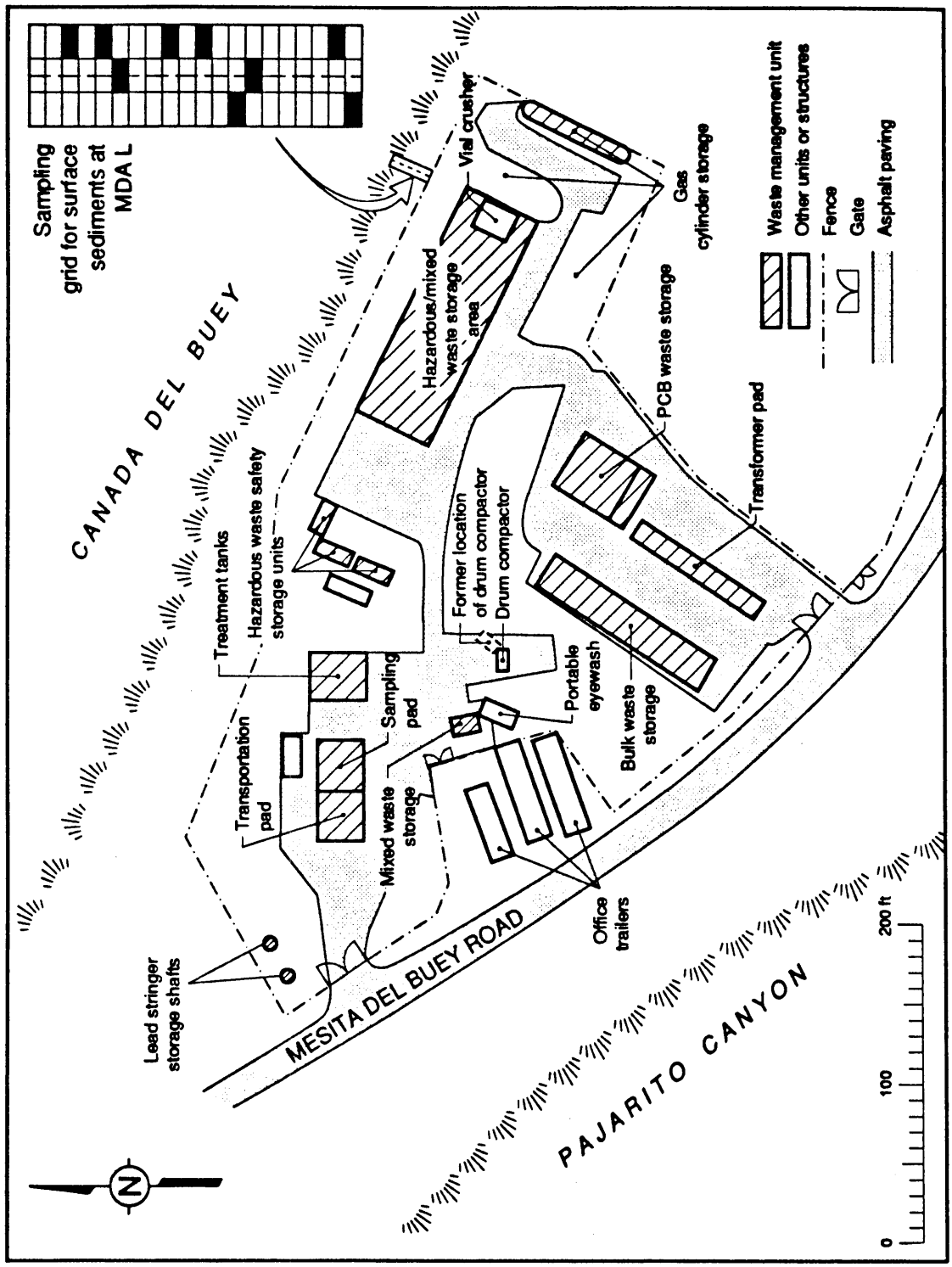


Figure 5.3-6 Surface sediment sampling locations at MDA L (base map modified from Benchmark Environmental Corp. 1990).

TABLE 5.3-15
PHASE II SURFACE SEDIMENT SAMPLING
AT MDA L

Media Samples	Phase II Sampling	Rationale	Analysis	# of
Sediment	6 locations	Sample to determine the extent of contamination.	COCs	6 + 4 QCs 10 Total

5.3.4.2.8 Health and Safety

This SAP will follow the procedures outlined in the Laboratory's Environment, Safety and Health Manual (LANL 1990, 0335) and Annex III of this RFI Work Plan.

5.3.4.2.9 Schedule

See Annex I.

5.3.4.3 Vertical and Angled Borehole Sampling at MDA L

5.3.4.3.1 Sampling and Analysis Components

The purpose of collecting and analyzing samples from vertical and angled boreholes at MDA L is to collect technically accurate and legally defensible data which can be used to characterize the vertical and horizontal extent of the contaminant release at MDA L. The sampling component of this task consists of drilling vertical and angled boreholes to collect continuous rock core samples and soil gas samples for chemical and radiological analyses. The analytical component consists of field and laboratory analysis of rock core and soil gas samples. Soil gas samples will be screened in the field for VOCs. Rock core samples will be screened in the field for VOCs and gross alpha, gross beta, and gross gamma ionizing radiation. Analysis at a Laboratory-contracted analytical laboratory will be conducted on core samples for VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, and gross alpha, gross beta, and gamma emitters. Soil gas samples will be analyzed at a contract analytical laboratory for VOCs. The data will be validated according to EPA functional guidelines for organic analysis (EPA 1988, 0293) and inorganic analysis (EPA 1988, 0296). Validation is necessary so that the quality of the data will be such that they can be used in risk assessment calculations. Currently, there are no published EPA methods for validating all radionuclide analyses.

Information obtained from laboratory analyses will be used to delineate the vertical and horizontal extent of the organic vapor plume emanating from MDA L. The residual concentration of any contamination in the rock units beneath MDA L will also be determined. Validated data from the sampling effort will be used to provide information for the VCAP design and implementation program.

5.3.4.3.2 Sampling and Analysis Approach

A phased drilling approach will be used to characterize subsurface contamination at MDA L. Rock core and soil gas samples will be collected from the proposed Phase I boreholes at MDA L. A continuous suite of rock core samples will be collected using hollow stem auger drilling techniques. Soil gas samples will be collected from sections of each borehole isolated and sealed by a packer. A sample of soil gas will be collected using either the TO-14 gas canister method (SUMMA®) in the grab sample mode or a resin tube method currently under development by Laboratory's EM-9 Group.

Rock core and soil gas samples will be shipped to a Laboratory-contracted analytical laboratory. All analyses for hazardous constituents will be performed according to EPA SW-846 (third edition) protocol. Analyses with tentatively identified compounds (TICs) will be reported in Level III SW-846 packages for subsequent data validation. Analysis for tritium, gross alpha, gross beta, and gamma emitters will be reported in data packages, formatted to LANL requirements for the off-site laboratory statement of work.

5.3.4.3.3 Primary Data Quality Factors

5.3.4.3.3.1 Prioritized Data Uses

- Site characterization - There is a large data base for VOCs already in existence for MDA L. However, the data do not include all of the regulated volatile organic compounds. Existing data have not been validated in accordance with the EPA functional guidelines. In addition, the data base does not include data for SVOCs, metals, pesticides, PCBs, cyanide, tritium, gross alpha, gross beta, or gamma emitters. Data will be collected to fill existing data gaps and to support the validity and use of the existing data base.

- Risk Assessment - The source term is not fully understood because the exact chemical constituents and quantities that were disposed of in MDA L are unknown. The rate of organic vapor generation and the flux emanating from the site are unknown. Data will be collected to determine the nature and extent of the vapor plume and other residual rock contamination at MDA L. These data will be used in risk assessment calculations.

- Voluntary Corrective Action Plan Design - The horizontal and vertical extent of the organic vapor plume has not been completely characterized by existing data. Data collected in the Phase I sampling program will provide information to fill existing data gaps. Phase I sampling will also provide data that are technically accurate and legally defensible, and that can be used in designing the VCAP.

5.3.4.3.3.2 Appropriate Analytical Levels

Samples collected will be screened in the field and analyzed in a laboratory using SW-846 protocol. PIDs, FIDs, and ECDs will be used in the field to screen for organic vapors immediately after samples have been collected. A field GC, in a mobile laboratory, will be used along with a PID or FID to determine qualitatively the hazardous constituents present.

Radiological screening of samples will be conducted for gross beta and gamma radioactivity and gross alpha contamination. Screening for gross beta and gamma radiation will be conducted with a hand-held sodium iodide detector (NaID) probe and

rate meter, or equivalent system. Screening for gross alpha contamination will be conducted with a hand-held alpha scintillation detector (ASD) and rate meter, or equivalent system. A windowless gas flow proportional (GFP) counter and a liquid scintillation counter in a mobile laboratory will be used for radiological screening, in addition to screening with the hand-held detectors. The levels of analysis are:

Level I Field Screen: PID/FID Instruments; NaID/ASD Instruments,

Level II Field Analysis: Field GC with PID/FID/ECD; Windowless GFP Counter; and Liquid Scintillation Counter,

Level III SW-846 Laboratory Methods, and

Level V Radionuclide Analysis Laboratory Methods.

5.3.4.3.3.3 Primary Contaminants of Concern

The primary contaminants of concern are VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, gross alpha, gross beta, and gamma emitters.

5.3.4.3.3.4 Levels of Concern

Appendix F of the IWP (LANL 1991, 0553) and 40 CFR 264, Proposed Subpart S, contain information on constituent levels of concern. Health risk-based determinations of levels of concern will be developed for constituents not listed in Appendix F. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 IWP. This approach will be developed in adequate time for data analysis.

5.3.4.3.3.5 Required Quantitation Limits

Quantitation limits for laboratory analysis of hazardous substances and radionuclides are presented in Tables V.3 through V.9 of the Laboratory's Generic QAPjP (LANL 1991, 0412). Although quantitation limits for laboratory analysis of soil gas have not been established, they will most likely fall in the range of the quantitation limits for soil.

5.3.4.3.3.6 Critical Samples

Samples collected from vertical borings at the distal edge, both vertically and horizontally, of the plume area are important in determining the nature and extent of the vapor plume. These samples are critical in determining future corrective action.

Pit A and Impoundments B, C, and D are potential primary sources of contamination at MDA L. Two borings will be drilled at angles under Pit A, and one angled borehole will be drilled under each impoundment. Critical samples will be those collected

directly under and closest to the pit and surface impoundments. These samples will most likely contain the widest array of contaminants with high concentration levels.

Samples collected from three deep boreholes near vapor monitoring well 12, Pit A, and the southeast perimeter fence corner are important in determining the existence of additional contaminants that are not part of the existing data base, and in validating existing data obtained from wells previously installed in these areas. Vapor monitoring systems will be installed in the newly-constructed boreholes.

One of the three deep boreholes will be located near vapor monitoring well 12, where high concentrations of 1,1,1-Trichloroethane (1,1,1-TCA) have been measured. The new deep borehole will be near seven disposal shafts that are believed to be source for volatile contaminants. The second deep borehole will be located near Pit A. Pit A is also in an area with a high concentration of 1,1,1,-TCA. The third deep borehole will be located at the southeast corner of the perimeter fence. This location is immediately downgradient of all the MDA L disposal pits and shafts, and heavier-than-air VOCs may be moving in this direction.

5.3.4.3.4. Rationale for Sampling Activity

The rationale for installing boreholes and vapor monitoring wells is to:

- further define the physical nature of the organic vapor plume and determine the nature and extent of any residual soil or rock contamination;
- further define the source term of the organic vapor plume and determine the source term for any residual soil or rock contamination; and
- collect data that can be validated according to EPA functional guidelines for data validation and that can be used to support the use of existing data.

Data obtained through implementation of the Phase I SAP will be used in the design of the VCAP for the MDA L vapor plume. This information will be obtained through the following sampling tasks:

Task 1. Borehole Installation

- Eleven vertical boreholes will be installed to delineate the horizontal and vertical extent of the organic vapor plumes (i.e., 1,1,1-TCA, toluene) and any residual soil or rock contamination.
- Five angled boreholes will be installed to determine the nature of any residual rock contamination beneath Pit A and the surface impoundments.
- Core samples will be collected and analyzed for VOCs, SVOCs, metals, pesticides, PCBs, cyanide, tritium, gross alpha, gross beta, and gamma emitters.
- Soil gas samples will be collected using resin tubes or SUMMA® canisters as the boring is advanced, and analyzed for VOCs.

Task 2. Vapor Monitoring Wells

- Vapor monitoring equipment (lines, ports, etc.) will be installed in the three deep vertical boreholes near existing wells and in the vicinity of disposal pits and shafts to support the data already obtained from the existing vapor monitoring wells.
- Soil gas samples will be collected using resin tubes or SUMMA® canisters and analyzed for VOCs.
- The new monitoring wells will be sampled during the sampling of the existing vapor monitoring wells (see Section 5.3.4.4).

5.3.4.3.5 Sampling Activity

5.3.4.3.5.1 Boreholes at MDA L

Eleven vertical and five angled boreholes will be installed during the Phase I sampling program. Three of the vertical boreholes will be advanced to a depth necessary to completely penetrate the organic vapor plume, which may extend to a depth of 300 ft or more. Vapor monitoring wells will be installed in these three vertical boreholes, which will be drilled to a depth of approximately 300 ft.

The remaining eight vertical boreholes will be drilled to a depth of approximately 100 ft. The boreholes will be advanced to a depth necessary to intercept and drill 10 ft beyond the surge bed (a permeable geologic feature), estimated to be 60 ft deep beneath MDA L. The actual depth of the vertical boreholes may vary, depending on the results of field analysis on soil, rock core, and soil gas. All vertical boreholes will continue to be advanced until no radiological contaminants or VOCs are detected by field screening techniques.

The five angled borings will be drilled at an incline of 30° from vertical to extend beneath Pit A and the three surface impoundments. The boreholes will be drilled to a total length of 50 ft. Proposed borehole and vapor monitoring system locations are shown on Figure 5.3-7. Table 5.3-16 is a sampling summary of the vertical and angled boreholes at MDA L. It lists the sampling interval for each media, the analyses to be performed, and the corresponding analytical levels. A detailed tabulation of sample intervals and corresponding analyses for each borehole is presented in Table B.3-3 of Appendix B. The ratio for quality control (QC) samples for sample collection activities is presented in Table B.10-1 of Appendix B. Table 5.3-17 summarizes the number of samples, the number of QC samples, and the analytical requirements for the Phase I borehole sampling at MDA L, and explains the types of QC samples required.

The procedures for borehole drilling and logging, sample (rock core) collection from the boreholes, field screening analyses, hydrogeologic measurements, downhole geophysical surveys, and waste disposal and borehole abandonment are described in Section 3.0 of Appendix B. Vapor monitoring well installation, soil gas sampling

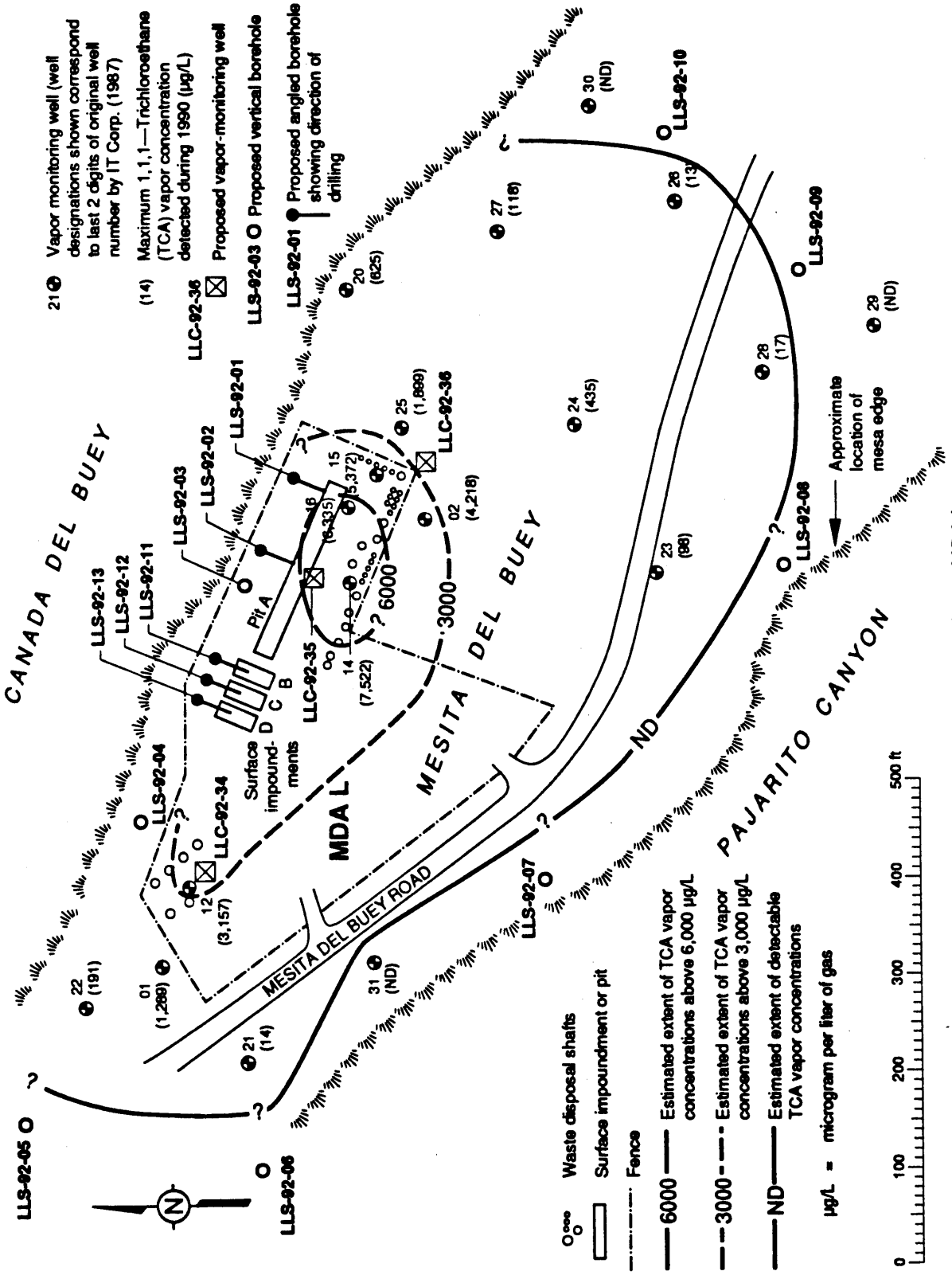


Figure 5.3-7 Location map of proposed vertical and angled boreholes at MDA L.

TABLE 5.3-16
SAMPLING SUMMARY FOR VERTICAL BOREHOLES AT MDA L

Analytical Level	Sampling[a] Interval	Analysis	Medium
Laboratory Analysis			
Level III	20 ft	VOCs	Rock Core
Level III	20 ft	SVOCs	Rock Core
Level III	20 ft	Metals	Rock Core
Level III	20 ft	Pesticides, PCBs, Cyanide	Rock Core
Level V	20 ft	Gross Alpha and Beta, Gamma Spectroscopy	Rock Core
Level III	20 ft	VOCs	Vapor
Level V	20 ft	Tritium	Rock Core
Field Screening or Analysis			
Level I	5 ft	Organic Vapors (PID/FID)	Rock Core
Level II	5 ft	Organic Vapors (Field GC)	Rock Core
Level I or II	5 ft	Alpha, Beta, & Gamma Emissions	Rock Core
Level II	5 ft	Gravimetric Moisture	Rock Core

SAMPLING SUMMARY FOR ANGLED BOREHOLES AT MDA L

Laboratory Analysis			
Level III	10 ft	VOCs	Rock Core
Level III	10 ft	SVOCs	Rock Core
Level III	10 ft	Metals	Rock Core
Level III	10 ft	Pesticides, PCBs, Cyanide	Rock Core
Level V	10 ft	Gross Alpha and Beta, Gamma Spectroscopy	Rock Core
Level III	10 ft	VOCs	Vapor
Level V	10 ft	Tritium	Rock Core
Field Screening or Analysis			
Level I	5 ft	Organic Vapors (PID/FID)	Rock Core
Level II	5 ft	Organic Vapors (Field GC)	Rock Core
Level I or II	5 ft	Alpha, Beta, & Gamma Emissions	Rock Core

[a] A sample will be collected at a minimum spacing of 20 ft (vertical boreholes) or 10 ft (angled boreholes) for analyses to confirm the absence or presence of COCs above the health risk-based criteria. The actual depth of the sample will be determined from the field screening and observation.

TABLE 5.3-17
PHASE I SAMPLING AND ANALYSIS PLAN TABLE FOR VERTICAL AND ANGLED BOREHOLE SAMPLING AT MDA L

Media	# of Samples	# of QC[a] Samples	Total Samples	Analysis
Rock Core	126	144	270	VOCs SVOCs Metals Pesticides PCBs Cyanide Gross Alpha Gross Beta Gamma Spectroscopy
Soil Gas (during borehole advancement)	126	144	270	VOCs

(a) Includes: Trip Blank, Field Blank, Duplicate Sample, and Equipment (Rinsate) Blank.

Trip Blank (Soil/Rock Core): Two 40 ml VOC sample containers filled with organic-free water at the Sample Coordination Facility. Filled trip blanks accompany sample bottles to the field, remain unopened throughout the sampling activity, and return with shipment to the analytical laboratory. Submitted only when sampling for VOCs.

Trip Blank (Soil Gas): A sealed SUMMA® canister or resin tube taken to the field during a sampling event and returned with shipment to the analytical laboratory. Canister or tube remains unopened.

Field Blank (Soil/Rock Core): Organic-free water is poured into sample containers at the site of the borehole sampling.

Field Blank (Soil Gas): A SUMMA® canister or resin tube is exposed to the atmosphere near the sampling site. The canister or tube will be left open until 3 liters of air are sampled.

Duplicate Sample (Soil/Rock Core): Collect two separate core samples immediately adjacent to each other by the same sampling technique.

Duplicate Sample (Soil Gas): Obtained by attaching two SUMMA® canisters or four resin tubes to the sample line with a Y fitting and filling the canisters or tubes simultaneously.

Equipment (Rinsate) Blank (Soil/Rock Core): Obtained by running organic-free water over cleaned, decontaminated sampling equipment. Rinse the equipment surface that comes into contact with a sample.

Equipment (Rinsate) Blank (Soil Gas): A gas sample, using a SUMMA® canister or resin tube, is taken to assess the cleanliness of the sample manifold. Clean the sample manifold, fill a 6L Teflon® bag with zero-zero air, and attach the bag and a canister or tubes to the manifold. Collect 3 liters using a flow rate of 500 ml/minute.

procedures, surveying and monitoring, and field screening procedures are presented in Section 6.0 of Appendix B.

5.3.4.3.6 Remaining SAP Elements

The remaining required elements of this SAP are common to all of the SAPs prepared for OU 1148. These common elements are listed in Table 5.3-12 and are located in Appendix B of this RFI Work Plan.

5.3.4.3.7 Phase II SAP

No additional angled boreholes will be drilled beneath Pit A or the three impoundments. Four additional 200-ft-deep vertical borings may be needed to further characterize the extent of contamination surrounding MDA L. Table 5.3-18 summarizes the Phase II sampling and analytical requirements.

5.3.4.3.8 Health and Safety

This SAP will follow the procedures outlined in the Laboratory's Environment, Safety and Health Manual (LANL 1990, 0335) and Annex III of this RFI Work Plan.

5.3.4.3.9 Schedule

See Annex I.

5.3.4.4 Existing Vapor Monitoring Wells Sampling at MDA L

5.3.4.4.1 Sampling and Analysis Components

The purpose of sampling and analyzing soil gas from the existing vapor monitoring wells at MDA L is to accumulate technically accurate and legally defensible data. The data will be used in the design inputs for the vapor plume corrective action model.

There will be four sampling tasks to determine the horizontal and vertical extent of the vapor plume in the subsurface surrounding MDA L, the in situ source term, and the effects of purge volumes. The data will be validated according to EPA functional guidelines for organic analysis (EPA 1988, 0293).

5.3.4.4.2 Sampling and Analysis Approach

A predetermined volume of soil vapor from the vapor monitoring wells access tubing will be purged, and a grab sample of soil gas will be collected using either the EPA TO-14 gas canister method (SUMMA®) or a resin tube method currently under development by LANL's EM-9 Group. The grab sample mode uses a flow controller

TABLE 5.3-18
PHASE II VERTICAL BOREHOLE SAMPLING AT MDA L

Media	Phase II Sampling	Rationale	Analysis	# of Samples
Rock Core	4 locations	Sample to further characterize the vertical and lateral extent of contamination.	COCs	64 + 80 QCs 144 Total

(or flow meter) and a vacuum gauge manifolded between the well sample tubing and the canister or resin tubes. Soil vapor samples will also be collected from the three deep vertical boreholes installed during this investigation (see Section 5.3.4.3). After collection, the samples will be shipped to a laboratory for analysis. The analyses to be performed will include VOCs according to EPA SW-846 (third edition) protocol, with tentatively identified compounds (TICs) reported in Level III SW-846 packages for subsequent data validation.

5.3.4.4.3 Primary Data Quality Factors

5.3.4.4.3.1 Prioritized Data Uses

The data to be collected are needed for site characterization, risk assessment, and inputs into the computer model that will be used to develop a VCAP. Each stage of data collection and use is outlined below.

- Site Characterization - A large data base already exists for MDA L; however, the data do not include all of the regulated VOC compounds and have not been validated according to EPA functional guidelines. The horizontal and vertical extent of the vapor plume has not been characterized adequately by existing data and there is no evidence that all of the regulated compounds have been defined.

- Risk Assessment - The rate at which organic vapors are being generated is not clear because the exact chemical constituents and quantities that were disposed of in MDA L are unknown. The total flux presently emanating from the site is also unknown. Data will be collected to determine the nature and extent of the vapor plume at MDA L. These data will be used in risk assessment calculations.

- Voluntary Corrective Action Design - Data collected during the Phase I and Phase II sampling will be used in computer models to develop the VCAP design for MDA L.

5.3.4.4.3.2 Appropriate Analytical Levels

Samples collected will be screened for VOCs in the field and analyzed for VOCs by a laboratory using SW-846 protocol. PIDs, FIDs, and ECDs will be used in the field to screen for organic vapors immediately after samples have been collected. A field GC, in a mobile laboratory, may be used along with a PID or FID to determine qualitatively the constituents present. The levels of analysis are:

Level I Field Screen: PID/FID Instruments,

Level II Field Analysis: Field GC with PID/FID/ECD, and

Level III SW-846 Laboratory Methods.

5.3.4.4.3.3 Primary Contaminants of Concern

The contaminants of concern at MDA L for this sampling activity are VOCs.

5.3.4.4.3.4 Levels of Concern

Appendix F of the IWP (LANL 1991, 0553) and 40 CFR 264, Proposed Subpart S, contain information on constituent levels of concern. Health risk-based determinations of levels of concern will be developed for constituents not listed in Appendix F. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 IWP. This approach will be developed in adequate time for data analysis.

5.3.4.4.3.5 Required Quantitation Limits

Quantitation limits are not established for soil gas monitoring. Table V.3 of the Laboratory's Generic QAPjP, however, gives quantitation limits for laboratory analysis of VOCs in soil (LANL 1991, 0412).

5.3.4.4.3.6 Critical Samples

Samples collected at the distal edge of the source, both vertically and horizontally, are important in determining the nature and extent of the vapor plume. Samples collected from within the plume and near disposal shafts and Pit A are important to characterizing COCs. All of these samples are critical in determining future corrective action.

5.3.4.4.4 Rationale For Sampling Activity

The reasons for sampling the existing vapor monitoring wells at MDA L are:

- to further define the physical nature of the vapor plume (i.e., the complete list of regulated VOCs using Level III analytical protocol);
- to further define the source term of the vapor plume by using Level III analytical protocol;
- to collect data that may support use of the existing data and that can be validated according to EPA functional guidelines for data validation;
- to sample the vapor monitoring wells using either the resin tube or TO-14 methods; and
- to verify that the existing data can be used in the VCAP modeling effort.

All of the data obtained through implementation of this SAP will be used in the design of the VCAP for the MDA L vapor plume. This information will be obtained through

the following sampling tasks:

Task 1. Horizontal Characterization

Eight existing vapor wells will be sampled to determine the horizontal extent of the vapor plume and to compare the data with the existing data base. A sample will be collected at each sample port (64 samples) from wells LLC-86-21, LLC-86-22, LLC-86-23, LLC-86-26, LLC-86-28, LLC-86-29, LLC-86-30, and LLC-86-31. SUMMA® canisters or resin tubes will be used for sample collection. Samples will be analyzed for EPA SW-846 VOCs (51 organic compounds).

Task 2. Vertical Characterization

Nineteen existing vapor wells will be sampled to determine the vertical extent of the vapor plume and to compare the data with the existing data base. A sample will be collected at the lowest sampling interval in the wells listed in Task 1, and in wells LLM-85-01, LLM-85-02, LLC-85-12, LLC-85-13, LLC-85-14, LLC-85-15, LLC-85-16, LLC-85-20, LLC-86-24, LLC-86-25, and LLC-86-87. Nineteen samples will be collected using SUMMA® canisters or resin tubes. These samples will be analyzed for EPA SW-846 VOCs (51 organic compounds).

Task 3. Vapor Plume Characterization

The nature of the vapor plume near the disposal trenches will be determined by sampling wells within the disposal area. This information will be compared to existing data. These wells include LLC-85-12 (27-foot depth), LLC-85-14 (46-foot depth), LLC-85-15 (31-foot depth), and LLC-5-16 (82-foot depth). The samples will be analyzed for EPA SW-846 VOCs (51 organic compounds) at the designated depths (4 samples) using resin tubes or SUMMA® canisters.

Task 4. Multiple Purge Volume Study

Data from samples collected with either SUMMA® canisters or resin tubes will be compared to determine if purge volumes affect sampling results. Twelve samples will be collected from wells LLM-85-01 (40-foot depth), LLM-85-02 (40-foot depth), LLC-85-24 (40-foot depth) and LLC-85-25 (65-foot depth). A total of three samples per well will be taken using purge volumes of 1, 10, and 100 volumes of the sample line (3 samples per well x 4 wells = 12 samples total). Multiple purge volumes will be used to determine if short-circuiting occurs and if movement of gas between sampling points transpires. The samples will be analyzed for EPA SW-846 VOCs (51 organic compounds).

5.3.4.4.5 Sampling Activity

Table 5.3-19 indicates, by task, the well numbers and the intervals to be sampled, the contaminants of concern, the number of SUMMA® or resin tube samples to be

collected, and the approximate number of quality control (QC) samples to be collected per task. Table 5.3-20 lists by well number the sample interval depths and purge volumes for each sample to be collected.

SUMMA® six-liter canisters or resin tubes will be used to collect soil gas vapor from the vapor monitoring wells in MDA L. The laboratory providing the precleaned, subatmospheric depressurized SUMMA® canisters will supply certificates of cleanliness for the canisters. Resin tube vendors will supply similar certificates, along with lot numbers.

All sample SUMMA® canisters or resin tubes and QC samples will be filled with 3L of atmosphere. Two resin tubes will be used in tandem to sample 3L of atmosphere. Soil gas sampling procedures are described in Section 6.0 of Appendix B. Table 5.3-21 lists the number of samples and QC samples and the analytical requirements for the Phase I sampling activity. It also describes the types of required QC samples. Figure 5.3-8 shows the locations of the vapor monitoring wells to be sampled.

Sampling events will be based on time of maximum vertical gas movement and samples will be collected once during a cool period (March, April, or May), and once during the following warm months (June, July, or August).

5.3.4.4.6 Remaining SAP Elements

The remaining required elements of this SAP are common to all of the SAPs prepared for OU 1148. These common elements are listed in Table 5.3-12 and are located in Appendix B of this RFI Work Plan.

5.3.4.4.7 Phase II SAPs

No additional sampling will be conducted under this RFI work plan. Additional sampling will be conducted as part of the requirements of the Laboratory's RCRA Operating Permit, Section B, Special Permit Conditions, Vadose Zone Research at TA-54 (Permit Number M890010515, page 6).

5.3.4.4.8 Health and Safety

This SAP will follow the procedures outlined in the Laboratory's Environment, Safety and Health Manual (LANL 1990, 0335) and Annex III of this RFI Work Plan.

5.3.4.4.9 Schedule

See Annex I.

TABLE 5.3-19
SAMPLE LOCATIONS AND QUANTITY OF SAMPLES

Task	Contaminants of Concern	Number of SUMMA® or Resin Tube Samples	Sample Interval	Number of QC Samples[1]
Task 1 Horizontal Characterization: Wells LLC-86-32,LLC-86-22, LLC-86-23, LLC-86-26, LLC-86-28, LLC-86-29, LLC-86-30, LLC-86-31	EPA SW-846 VOCs (51 organic compounds)	64	At each sampling interval	4 trip blanks 4 equipment blanks 4 ambient samples 4 duplicate samples
Task 2 Vertical Characterization: Wells in Task 1 and Wells LLM-85-01, LLM-85-02, LLC-85-12, LLC-85-13, LLC-85-14, LLC-85-15, LLC-85-16, LLC-85-20, LLC-85-20, LLC-86-24, LLC-86-225, LLC-86-27	EPA SW-846 VOCs (51 organic compounds)	19	At the lowest sampling interval	1 trip blank 1 equipment blank 1 ambient sample 1 duplicate sample
Task 3 Vapor Plume Characterization: Wells LLC-85-12, LLC-85-14, LLC-85-15, LLC-85-16	EPA SW-846 VOCs (51 organic compounds)	4	LLC-85-12 (27') LLC-85-12 (46') LLC-85-15 (31') LLC-85-16 (82')	1 trip blank 1 equipment blank 1 ambient sample 1 duplicate sample
Task 4 Purge Volume Study Wells LLM-85-01, LLM-85-02, LLC-85-24, LLC-85-25	EPA SW-846 VOCs (51 organic compounds)	12	LLM-85-01 (40') 1, 10, 100 purge volumes; LLM-85-02 (40') @ 1, 10, 100 purge volumes; LLC-85-24 (40') @ 1, 10, 100 purge volumes; LLC-86-25 (60') @ 1, 10, 100 purge volumes	1 trip blank 1 equipment blank 1 ambient sample 1 duplicate sample
New Vapor Monitoring Wells LLC-92-34, LLC-92-35 LLC-92-36 (see Section 5.3.4.3)	EPA SW-846 VOCs (51 organic compounds)	TBD	TBD	TBD

[1] Each QC sample will be submitted to the laboratory at a rate of one per twenty samples collected, or one each per sampling shipment, if less than twenty media samples are submitted per day

TBD To be determined.

TABLE 5.3-20
PURGE VOLUMES FOR VAPOR MONITORING WELLS AT MDA L

Well Number	Sample Interval Depth (in feet below surface)	Purge Volumes (in ml)
LLM-85-01	40	200.21
	200	1,001.04
LLM-85-02	40	200.21
	200	1,001.04
LLC-85-12	27	135.14
	42	210.22
LLC-85-13	63	315.33
LLC-85-14	46	230.24
	86	430.45
LLC-85-15	31	155.16
	82	410.43
LLC-85-16	82	410.43
LLC-86-20	200	1,001.04
LLC-86-21	20	100.01
	40	200.21
	60	300.31
	80	400.42
	95	475.49
	120	600.62
	140	700.73
	160	800.83
	180	900.94
	200	1,001.04
LLC-86-22	20	100.10
	40	200.21
	60	300.31
	80	400.42
	100	500.52
	120	600.62
	140	700.73
	160	800.83
	180	900.94
	197	986.02
LLC-86-23	20	100.10
	40	200.21
	60	300.31
	80	400.42
	100	500.52
	120	600.62
	140	700.73
	160	800.83
	180	900.94
	200	1,001.04
LLC-86-24	40	200.21
	200	1,001.04

TABLE 5.3-20, Continued
PURGE VOLUMES FOR VAPOR MONITORING WELLS AT MDA L

Well Number	Sample Interval Depth (in feet below surface)	Purge Volumes (in ml)
LLC-86-25	60	300.31
	190	950.99
LLC-86-26	20	100.10
	60	300.31
	100	500.52
	160	800.83
	200	1,001.04
	215	1,076.12
LLC-86-27	250	1,251.30
LLC-86-28	60	300.31
	100	500.52
	160	800.83
	200	1,001.04
	220	1,101.14
	250	1,251.30
LLC-86-29	20	100.10
	60	300.31
	100	500.52
	160	800.83
	200	1,001.04
	220	1,101.14
	260	1,301.35
	288	1,441.50
LLC-86-30	20	100.10
	60	300.31
	100	500.52
	160	800.83
	200	1,001.04
	220	1,101.14
	243	1,216.26
LLC-86-31	20	100.10
	60	300.31
	100	500.52
	160	800.83
	200	1,001.04
	220	1,101.14
	260	1,301.35
LLC-92-34	TBD	TBD
LLC-92-35	TBD	TBD
LLC-92-36	TBD	TBD

TBD To be determined during instrumentation of boreholes (see Section 5.3.4.3).

TABLE 5.3-21
PHASE I SAMPLING AND ANALYSIS PLAN TABLE FOR VAPOR MONITORING WELL SAMPLING AT MDA L

Media	# of Samples	# of QC[a] Samples	Total Samples	Analysis
Soil gas with SUMMA® canisters or resin tubes	99[b]	20[b]	119[b]	VOCs

(a) Includes: Trip Blank, Field Blank (Ambient Sample), Duplicate Sample, and Equipment (Sample Manifold) Blank.

Trip Blank: A SUMMA® canister or resin tubes that are taken to the field during a sampling event and then shipped back to the analytical laboratory along with the field samples. The trip blank will remain unopened both from and to the laboratory.

Field Blank (Ambient Sample): A SUMMA® canister or resin tubes that are exposed to the atmosphere near the sampling site to assess the atmosphere at the sampling site. Leave the canister or resin tubes open for the time period required to take three liters of air sample.

Duplicate Sample: A field duplicate of soil gas obtained by attaching two canisters or four resin tubes to the sample line using a Y fitting. Canisters or resin tubes are filled simultaneously.

Equipment (Sample Manifold) Blank: A sample taken using a SUMMA® canister or resin tubes to assess the cleanliness of the sample manifold. Clean and decontaminate the sample manifold and fill a six-liter Teflon® bag with zero-zero air. Attach the bag and canister or tubes to the manifold and collect three liters of air using a flow rate of 500 ml/min.

(b) Does not include number of samples to be collected from newly-installed vapor monitoring wells (see Section 5.3.4.3)

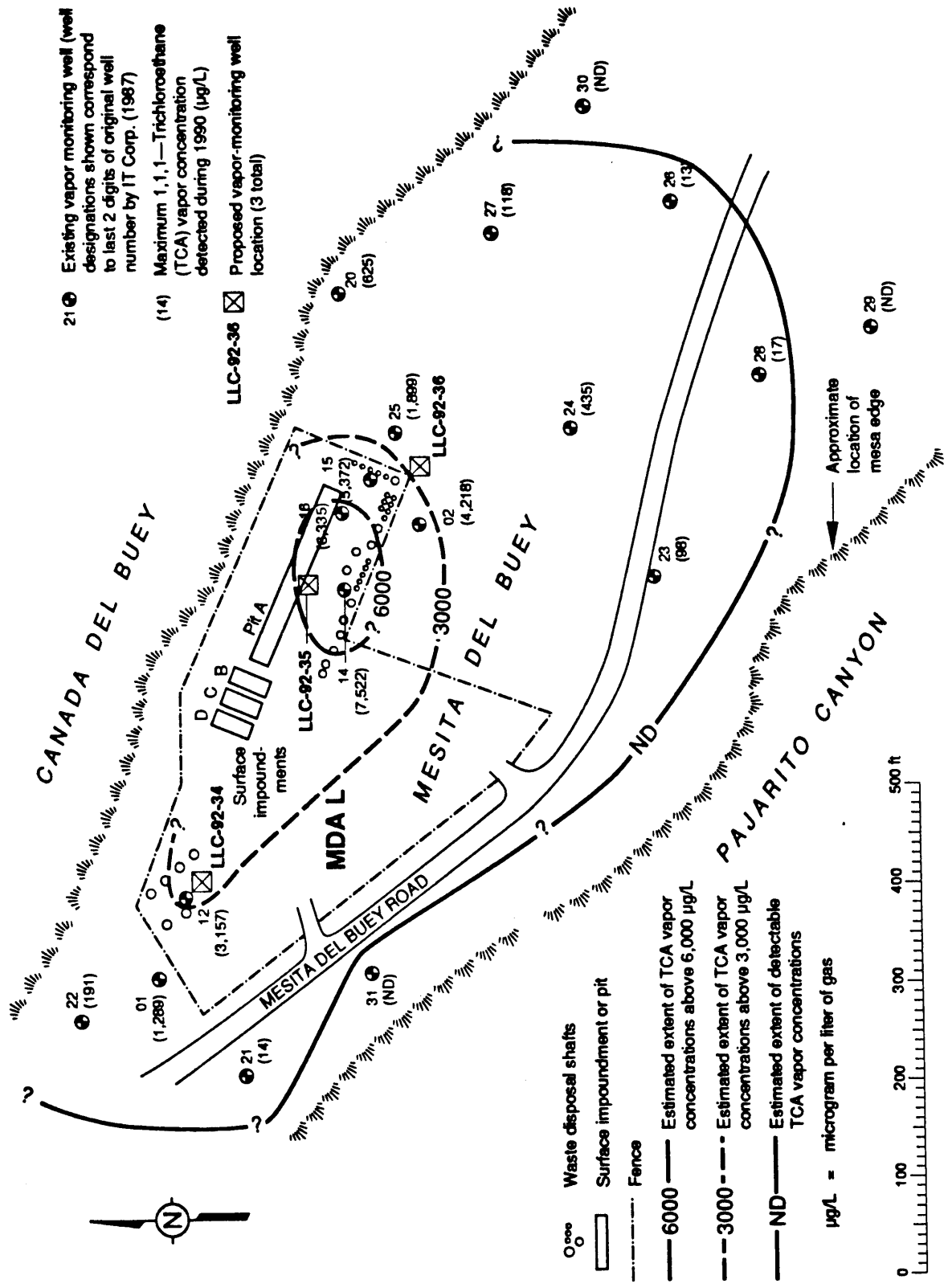


Figure 5.3-8 Vapor monitoring well locations at MDA L.

5.3.4.5 Passive Air Sampling at MDA L

5.3.4.5.1 Sampling and Analysis Components

The purpose of collecting and analyzing passive air samples at MDA L is to accumulate technically accurate and legally defensible data. The data will be used to characterize the nature, type, and extent of contamination by VOCs at MDA L. This information will be used in the Phase I assessment to determine the flux rate of VOCs emanating out of the ground to the atmosphere at MDA L.

The sampling component will consist of collection of passive air samples at the ground surface using EMFLUX® sample cartridges. The analysis component will consist of VOC analysis by Quadrel Services Inc. The data will be validated according to EPA functional guidelines for organic analysis (EPA 1988, 0293).

5.3.4.5.2 Sampling and Analysis Approach

Soil gas emanating from the ground will be sampled using EMFLUX® sample cartridges, which are stainless steel mesh and wire cartridges containing approximately 100 mg of selected adsorbent material. The sample cartridges will be placed at surveyed sampling points on a predetermined grid. Cartridges will be exposed to the soil surface for a period of 72 hrs in order to capture soil gas by passive adsorption. To increase survey sensitivity and accuracy, the EMFLUX® system is designed to take maximum advantage of the phenomenon known as earth tides, the dominant geophysical forces governing vertical movement of trace gases through the earth's crust. In addition, the barometric pressure will be monitored before, during, and after the sampling period. The sampling window will be synchronized with a period of low atmospheric pressure, if possible.

The samples will be sent to the Sample Coordination Facility (SCF), where they will be shipped to Quadrel Services Inc. environmental laboratories for analysis. The analyses to be performed include VOCs, following EPA SW-846 (third edition) protocol, with a ten compound library search and tentatively identified compounds (TICs). Results will be reported in Level III SW-846 packages for subsequent data validation.

5.3.4.5.3 Primary Data Quality Factors

5.3.4.5.3.1 Prioritized Data Uses

The data to be collected are needed for site characterization, risk assessment, and inputs into the computer model that will be used to develop a VCAP. Each stage of data collection and use is outlined below.

- Site Characterization - A large data base already exists for MDA L; however, the data do not include all of the regulated VOC compounds.

Passive air sampling is an inexpensive, nonintrusive means of collecting data in and surrounding MDA L.

The nature and extent of VOCs emanating from the ground to the atmosphere have not been characterized by existing data and there is no evidence that all of the regulated compounds have been defined in a manner that is technically correct or legally defensible under the requirements of the SW-846 program. Passive air sampling data will be used for site characterization.

- Risk Assessment - The rate at which organic vapors are being generated is not clear because the exact chemical constituents and quantities that were disposed of in MDA L are unknown. The total flux presently emanating from the site is also unknown. Data will be collected to determine the nature and extent of the vapor plume at MDA L. These data will be used in risk assessment calculations.

- Voluntary Corrective Action Design - Data collected during the Phase I and Phase II sampling will be used in computer models to develop the VCAP design for MDA L.

5.3.4.5.3.2 Appropriate Analytical Levels

Immediately after scoring the soil for placement of the sample cartridge, the soil surface will be screened for organic vapors with PIDs, FIDs, or ECDs. Screening for radionuclides will be conducted with a hand-held ASD for gross alpha contamination, and a hand-held NaID for gamma radioactivity. The various analytical levels established for this sampling plan are as follows:

Level I Field Screen: PID/FID Instruments; NaID/ASD Instruments,

Level II Field Analysis: Field GC with a PID, FID, or ECD; Windowless GFP Counters; Liquid Scintillation Counter, and

Level III SW-846 Laboratory Methods.

5.3.4.5.3.3 Primary Contaminants of Concern

The primary contaminants of concern at MDA L for this sampling activity are VOCs.

5.3.4.5.3.4 Levels of Concern

Appendix F of the IWP (LANL 1991, 0553) and 40 CFR 264, Proposed Subpart S, contain information on constituent levels of concern. Health risk-based determinations of levels of concern will be developed for constituents not listed in Appendix F. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 IWP. This approach will be developed in adequate time for data analysis.

5.3.4.5.3.5 Required Quantitation Limits

Quantitation limits are not established for soil gas monitoring. Table V.3 of the Laboratory's Generic QAPjP, however, gives quantitation limits for laboratory analysis of VOCs in soil (LANL 1991, 0412).

5.3.4.5.3.6 Critical Samples

Samples collected at the distal edge of the source are important in determining the nature and extent of VOCs emanating from the ground to the atmosphere. These samples are critical in determining future corrective action.

5.3.4.5.4 Rationale For Sampling Activity

The rationale for passive air sampling at MDA L is to further define the physical nature of the vapor plume using an inexpensive means of multiple sampling, and to further define the source term of the vapor plume. All of the data obtained through implementation of this SAP will be used for further site characterization and in the design of the VCAP for the MDA L vapor plume. This information will be obtained through the following sampling tasks.

Task 1. Grid Layout and Sample Point Designation

The EPA "Field Manual for Grid Sampling of PCB Spill Sites to Verify Cleanup" (EPA 1986, 0645) was used in determining the grid layout and sample point designation for the passive air sampling task in MDA L. The manual provides guidance for designing hexagonal sampling grids which represent a statistically valid method for determining the extent of contamination from a chemical release. Figure 5.3-9 shows the points to be sampled.

Task 2. Horizontal Characterization

Twenty-one surface locations with a radius of 570 ft will be sampled to identify the horizontal extent of organic vapor emanation, as defined at the surface. An additional 16 samples will be collected along the mesa wall above Cañada del Buey to determine if VOCs are emanating from the north wall of Mesita del Buey. One sample will be collected at each designated sampling point using EMFLUX® sample cartridges and will be analyzed for VOCs (51 compounds) with a ten compound library search following EPA SW-846 protocol.

Task 3. Source Term Characterization

The source term of the vapor plume near the waste disposal shafts and the storage impoundment pit will be characterized by sampling two separate grids, each having its own radius center. The EPA Midwest Research Institute grid layout (EPA 1986, 0645) in the northernmost section of the site will contain 14 surface sampling locations within a radius of 55 ft. The

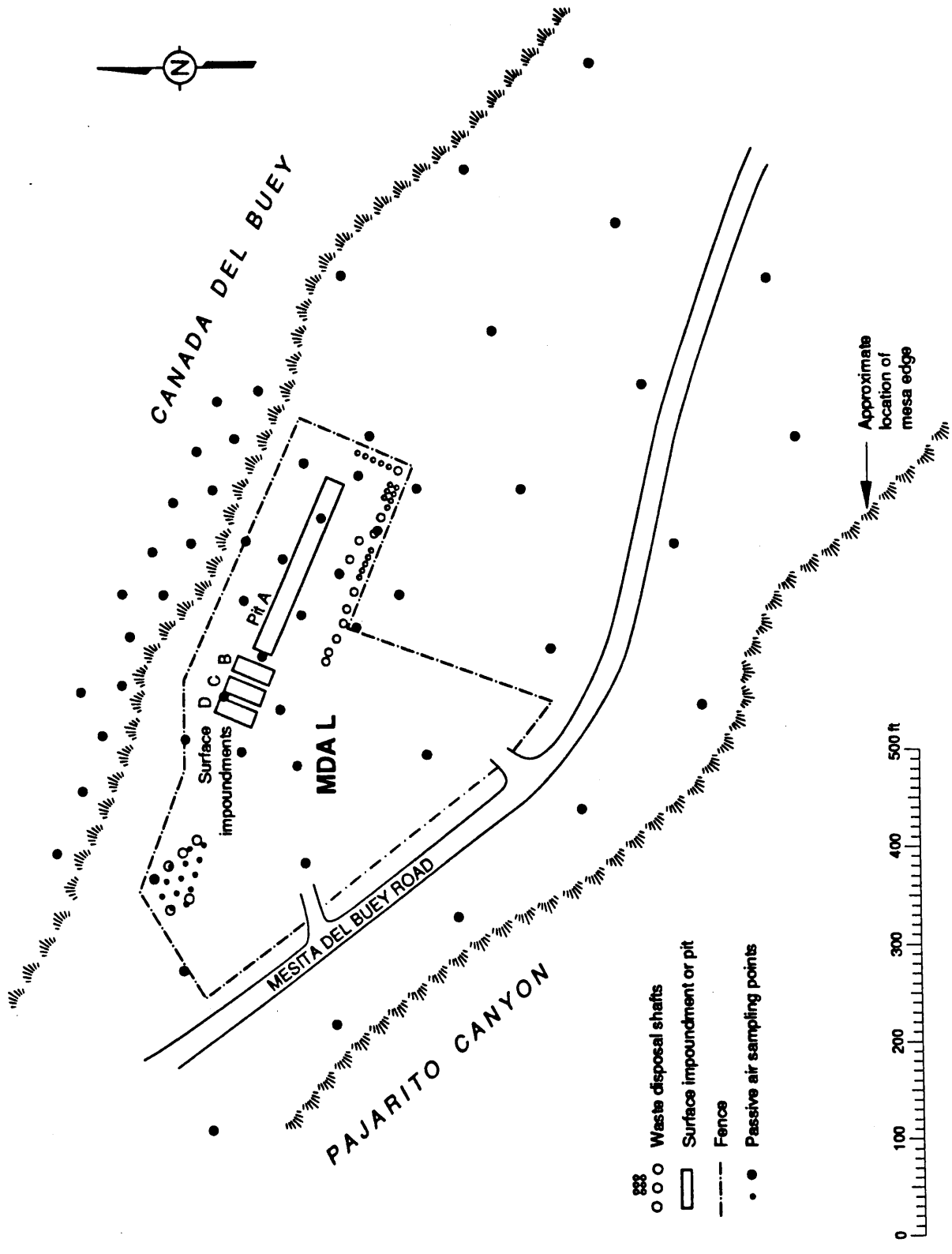


Figure 5.3-9 Passive air sampling locations at MDA L. (Base map modified from IT Corp. 1987 and 1991.)

area surrounding Pit A will contain 17 surface sampling locations within a radius of 207 ft. These samples will be collected using the EMFLUX® sample cartridges and will be analyzed for EPA SW-846 VOCs (51 compounds) with a ten compound library search.

Task 4. Data Reduction

All data will be validated according to the EPA functional guidelines for organic analysis (EPA 1988, 0293). This will provide the highest quality data for site characterization.

5.3.4.5.5 Sampling Activity

A total of 136 passive air samples will be collected at MDA L (68 samples x 2 sampling events = 136). The location of each sampling point is shown on Figure 5.3-9. Table 5.3-22 lists the number of samples, the number of QC samples, and the analytical requirements for the Phase I investigation. It also describes the types of QC samples required. Soil gas sampling procedures are presented in Section 6.0 of Appendix B.

EMFLUX® cartridges will be used to collect passive air samples in MDA L. The Quadrel Services Inc. laboratory, providing the precleaned cartridges, will supply certificates of cleanliness for the cartridges. All sample EMFLUX® cartridges will be left on site for a 72-hr period. If adsorption is allowed to continue for longer than 72 hours, breakthrough may occur.

Sampling events will be based on time of maximum vertical gas movement and will occur once during a cool period (March, April, or May), and once during the following warm months (June, July, or August). Periods of maximum vertical gas movement will be determined by Quadrel Services, Inc., and the samples will be collected during that time.

The timing of collector deployment and the length of the survey sampling period are critical elements of the EMFLUX® system. For each project, and well in advance of anticipated field work, Quadrel will furnish the date and hour by which all collection devices must be in place, using for this determination the company's computerized earth-tide/gas-migration model.

5.3.4.5.6 Remaining SAP Elements

The remaining required elements of this SAP are common to all of the SAPs prepared for OU 1148. These common elements are listed in Table 5.3-12 and are located in Appendix B of this RFI Work Plan.

5.3.4.5.7 Phase II SAP

Data collected during the proposed Phase I sampling effort will produce a "snapshot in time" to provide characterization of the VOC flux emanating from MDA L. No Phase II sampling using this technique is proposed for the mesa top. However,

TABLE 5.3-22
SAMPLING AND ANALYSIS PLAN TABLE FOR PASSIVE AIR SAMPLING AT MDA L

Media	# of Samples	# of QC[a] Samples	Total Samples	Analysis
Soil gas with	136	30	166	VOCs

(a) Includes: Trip Blank, Field Blank, and Duplicate Sample.

Trip Blank: An EMFLUX® cartridge that is taken to the field during a sampling event and then shipped back to the analytical contractor along with the field samples. The trip blank will remain unopened both from and to the laboratory.

Field Blank (Ambient or Control Point Sample): A sample taken to assess the ambient conditions at the sampling site. An EMFLUX® sampling device is set up on a control point barrier (3 or 4 layers aluminum foil) near a designated sampling point and the cartridge is exposed for the time period required for EMFLUX® sampling devices. One control point sample will be taken for every 10 samples.

Duplicate Sample: Collocated soil gas samples obtained by placing two sample cartridges adjacent to each other. Both cartridges will be exposed simultaneously and submitted to the analytical contractor through the SCF as consecutive samples.

based upon the results of the Phase I sampling, Phase II passive air sampling along the south mesa wall may be conducted in the vicinity of MDA L. Five locations along the mesa wall above Pajarito Canyon will be sampled if the flux rate of VOCs on the mesa top and/or along the north mesa wall appears to exceed health risk-based criteria. Table 5.3-23 summarizes the Phase II passive air sampling plan for MDA L.

5.3.4.5.8 Health and Safety

This SAP will follow the procedures outlined in the Laboratory's Environment, Safety and Health Manual (LANL 1990, 0335) and in Annex III of this RFI Work Plan.

5.3.4.5.9 Schedule

See Annex I.

5.3.4.6 High-Volume Air Sampling at MDA L

5.3.4.6.1 Sampling and Analysis Components

The purpose of collecting and analyzing high-volume air samples at MDA L is to accumulate technically accurate and legally defensible data. The data will be used to determine the extent of atmospheric transport of contaminants from MDA L and to quantify the range of pollution concentration over the sampling period. Data will be collected in accordance with EPA-accepted sampling and analysis procedures and the guidelines specified in this document. The data will be validated according to EPA functional guidelines for organic analysis (EPA 1988, 0293) and inorganic analysis (EPA 1988, 0296). Validation is necessary so that the data will be of such quality that they can be used in risk assessment calculations. Currently, there are no published EPA methods for validating all radionuclides analyses.

5.3.4.6.2 Sampling and Analysis Approach

This SAP is designed to determine the extent to which contaminants at MDA L impact air quality in the surrounding area. Because the sources of air contamination are all at ground level, worst-case (off-site) air pollution problems can be expected to occur at the fence line. The proposed sampling plan will provide an indication of baseline air quality in the immediate vicinity of MDA L. Data derived from this study will provide an indication of the extent of the air pollution problems caused by the release into the air of materials stored on site. In addition, these data will be used to determine whether the severity of the air quality impact warrants Phase II sampling. Furthermore, these data will be used as inputs into risk assessment.

The north fence line of MDA L is located along the edge of Mesita del Buey above Cañada del Buey. Because the pits and shafts at MDA L are extremely close together, a sampling system has been established to determine an overall off-site impact. The meteorological parameter of greatest importance in choosing air sampling locations for MDA L is the predominant wind direction relative to the site.

TABLE 5.3-23
PHASE II PASSIVE AIR SAMPLING AT MDA L

Media	Phase II Sampling	Rationale	Analysis	# of Samples
Air	10 locations	Sample if VOCs exceed health risk-based criteria in Phase I.	VOCs	20 + 6 QCs 26 Total

Wind directions and speeds at MDA G, just east of MDA L, are discussed in Section 3.1.4.1.

5.3.4.6.3 Primary Data Quality Factors

5.3.4.6.3.1 Prioritized Data Uses

The data to be collected are necessary for site characterization and risk assessment. Collected data will be used to establish whether any airborne contaminants from MDA L are being transported off site. The data will also be used to determine the potential impact of windborne contaminants on human populations or agricultural activities, and whether this impact warrants Phase II sampling.

5.3.4.6.3.2 Appropriate Analytical Levels

Samples collected will be screened in the field and analyzed in a laboratory using EPA SW-846 (third edition) protocol. Alpha, beta, and gamma survey instruments will be used in the field to screen the samples before they are shipped to the Sample Coordination Facility (SCF). The levels of analysis are:

Level I Field Screen: Alpha, beta, gamma survey instruments,

Level III SW-846 Laboratory Methods , and

Level V Radionuclide Analysis Laboratory Methods.

5.3.4.6.3.3 Primary Contaminants of Concern

The contaminants of concern for this sampling activity at MDA L are SVOCs, metals, pesticides, PCBs, gross alpha, gross beta, and gamma emitters, and total suspended particulates (TSPs).

5.3.4.6.3.4 Levels of Concern

Appendix F of the IWP (LANL 1991, 0553) and 40 CFR 264, Proposed Subpart S, contain information on constituent levels of concern. Health risk-based determinations of levels of concern will be developed for constituents not listed in Appendix F. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 IWP. This approach will be developed in adequate time for data analysis.

5.3.4.6.3.5 Required Quantitation Limits

Quantitation limits for all parameters are presented in Tables V.3 through V.9 of the Laboratory's Generic QAPjP (LANL 1991, 0412).

5.3.4.6.3.6 Critical Samples

Samples collected at the following locations are critical to the objectives of this study: 1) directly downwind of the most contaminated areas of MDA L, 2) in the direction of White Rock, and 3) in the direction of Los Alamos. The first location will provide information regarding the magnitude of the air quality impact of airborne contaminants that may be transported off site, and the latter two will provide a measure of contaminants that may impact the nearest human populations.

5.3.4.6.4 Rationale for Sampling Activity

The rationale for high-volume air sampling from the four locations at MDA L is to:

- collect air quality data at the boundary of MDAL to determine if SVOCs, metals, pesticides, PCBs, gross alpha, gross beta, and gamma emitters, and TSPs are being transported off site; and
- collect data that can be used in a risk assessment.

5.3.4.6.5 Sampling Activity

High-volume air samples will be collected at four locations in MDA L (Figure 5.3-10). The justification for each sampling location is provided in Table 5.3-24. A GPS-1 high-volume air sampler will be used to collect air samples for analysis of SVOCs, metals, pesticides, PCBs, and gross alpha, gross beta, and gamma emitters. Air samples for analysis of TSPs will be collected with a high-volume particulate air sampler. No analysis of samples will be conducted in the field.

Samples will be collected once a month for a three-day period (72 h). Samples will be collected each month for one year (4 samples x 12 months = 48 samples). The number of samples and QC samples and the types of QC samples is given in Table 5.3-25. Sample collection procedures are presented in Section 7.0 of Appendix B.

5.3.4.6.6 Remaining SAP Elements

The remaining required elements of this SAP are common to all of the SAPs prepared for OU 1148. These common elements are listed in Table 5.3-12 and are located in Appendix B of this RFI Work Plan.

5.3.4.6.7 Phase II SAP

If the results of Phase I sampling indicate that COCs exceed health risk-based criteria, Phase II soil sampling will be conducted at MDA L. Since treatment, storage, and volume reduction activities are ongoing at MDA L, three soil samples will be collected: one each at or near the oil storage pad, the chemical waste storage pad, and the drum crusher. These samples will be collected and analyzed to determine if the active units are the source of the COCs. Table 5.3-26 summarizes the Phase II sampling activities.

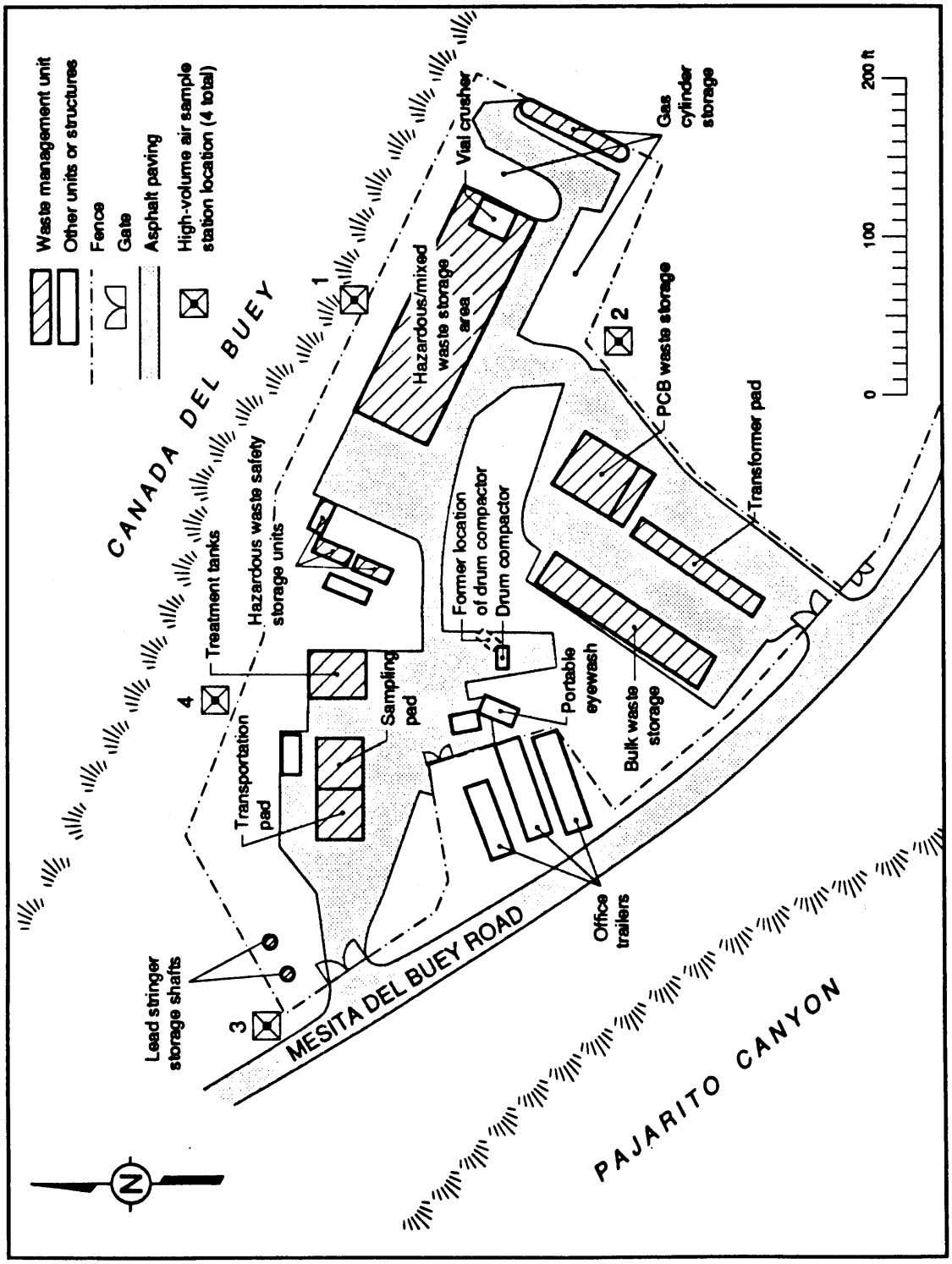


Figure 5.3-10 High-volume air sampling locations at MDA L (base map modified from Benchmark Environmental Corp. 1991).

TABLE 5.3-24
JUSTIFICATION FOR DETERMINING HIGH-VOLUME AIR SAMPLING LOCATIONS

Monitor No.	Justification
1	Based upon predominant south-southwesterly winds
2	In line with MDA L and town of White Rock
3	In line with MDA L and town of Los Alamos
4	Based upon predominant south-southwesterly winds and location of active treatment sites

TABLE 5.3-25
PHASE I SAMPLING AND ANALYSIS PLAN TABLE FOR HIGH-VOLUME AIR SAMPLING AT MDA L

Media	# of Samples	# of QC[a] Samples	Total Samples	Analysis
Air (PUF/XAD Filters and Cartridges)	48	24	72	SVOCs Metals Pesticides PCBs Gross Alpha Gross Beta Gamma Spectroscopy
Air (Glass-Fiber Paper Filters)	48	24	72	Total Suspended Particulates

(a) Includes: Duplicate Sample and Equipment Blank.

Equipment Blank: A GPS-1 high-volume sampler PUF/XAD filter and cartridge and a high-volume particulate sampler glass-fiber paper filter will be transported to the field during each sampling event and then shipped back to the Sample Coordination Facility with the field samples.

Duplicate Samples: Collect two separate samples simultaneously from the same location.

TABLE 5.3-26
PHASE II HIGH-VOLUME AIR (SOIL) SAMPLING AT MDA L

Media	Phase II Sampling	Rationale	Analysis	# of Samples
Soil	3 locations	Sample if COCs exceed health risk-based criteria during Phase I.	COCs	3 + 4 QCs 7 Total

5.3.4.6.8 Health and Safety

This SAP will follow the procedures outlined in the Laboratory's Environment, Safety and Health Manual (LANL 1990, 0335) and Annex III of this RFI Work Plan.

5.3.4.6.9 Schedule

See Annex I.

5.4 Material Disposal Area G

5.4.1 Background

MDA G is the main site for the storage and disposal of radioactive solid waste at the Laboratory. MDA G is located within TA-54 on Mesita del Buey approximately 2 miles southeast of the intersection of Pajarito Road and Rex Drive, the access road. Figure 5.4-1 is a location map of MDA G showing the locations of shafts, pits and trenches used for storage and disposal of radioactive waste. The locations of surface SWMUs at MDA G are shown on Figure 5.4-2.

5.4.1.1 Description and History of MDA G

The original design for MDA G specified that the construction of pits should begin near the central axis of the mesa and proceed toward the edges to a distance no closer than 50 ft from the mesa edge. The pits were also to be kept as far as practical from the well-defined drainage courses that dissect the mesa (Rogers 1977, 0216). Disposal of routine radioactive waste began in Pit 1 on January 2, 1959, and storage continues in MDA G to this day.

MDA G pits and trenches were originally designed to be up to 600 ft long and 100 ft wide, with ramps at either end having slopes of 6:1 and 4:1. Construction specifications for the ramps indicated horizontal distances of 150 ft for the 6:1 slope, and 100 ft for the 4:1 slope. The depth of the pits was designed to be at least 25 ft, with walls as nearly vertical as excavating equipment would permit (Rogers 1977, 0216). These design specifications were later modified due to field conditions; actual dimensions of each pit are listed in the SWMU Report (LANL 1990, 0145). Where possible, the pits were excavated to depths of the canyon floor, or approximately 60 feet deep (IT Corporation 1992, 08-0008).

Shafts were constructed at MDA G to provide better containment and to reduce external radiation from the waste. Shafts were bored at a minimum of 7.5 ft from center to center, and vary from 25 to 75 ft in depth, as specified or as determined by field conditions (Rogers 1977, 0216). The actual dimensions of each shaft are listed in the SWMU Report (LANL 1990, 0145).

Shafts are lined or unlined, depending on the waste they contain. Unlined shafts are 2 ft or 3 ft in diameter and 25 ft deep. They contain a variety of radioactive solid waste, including contaminated animal tissue, classified materials, chemicals, and high-level beta-gamma waste above 5 R/hr at the surface of the drum. (Current waste management practices may use a screening limit lower than 5 R/hr). Lined shafts are 3 ft in diameter, and were constructed by centering a 12-in-diameter metal casing to within 1 ft above the bottom of the shaft. Cement was poured around the casing and finished at the top of the shaft to promote drainage away from the shaft. Lined shafts contain very high activities of fission product and tritium waste.

Surface SWMUs that are included in the MDA G SWMU Aggregate are a septic system, a compactor, surface storage areas, and a sump (LANL 1990, 0145) (Figure 5.4-2). The septic system, SWMU 54-007(a), serves TA-54-2 (the compactor

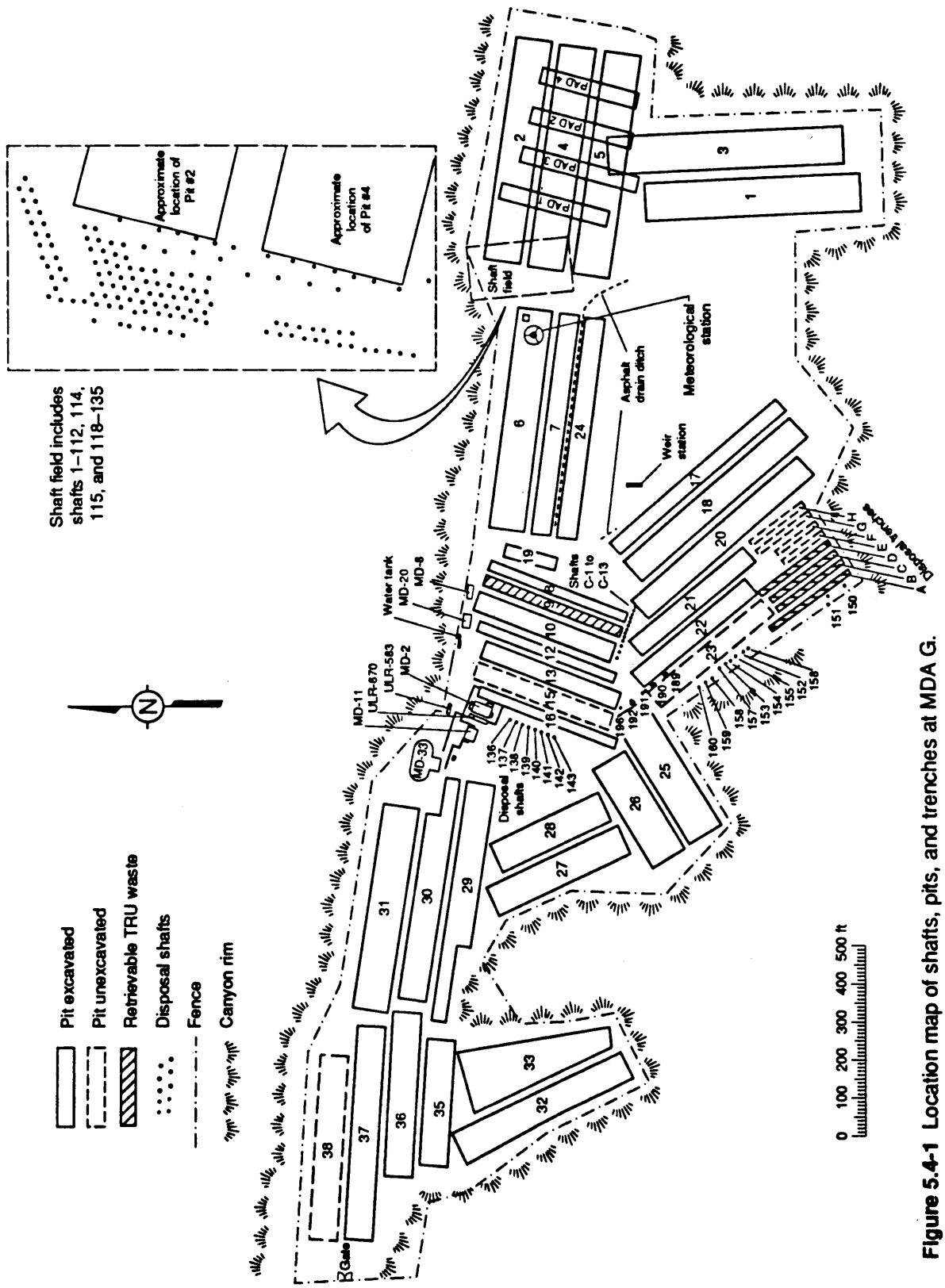


Figure 5.4-1 Location map of shafts, pits, and trenches at MDA G.

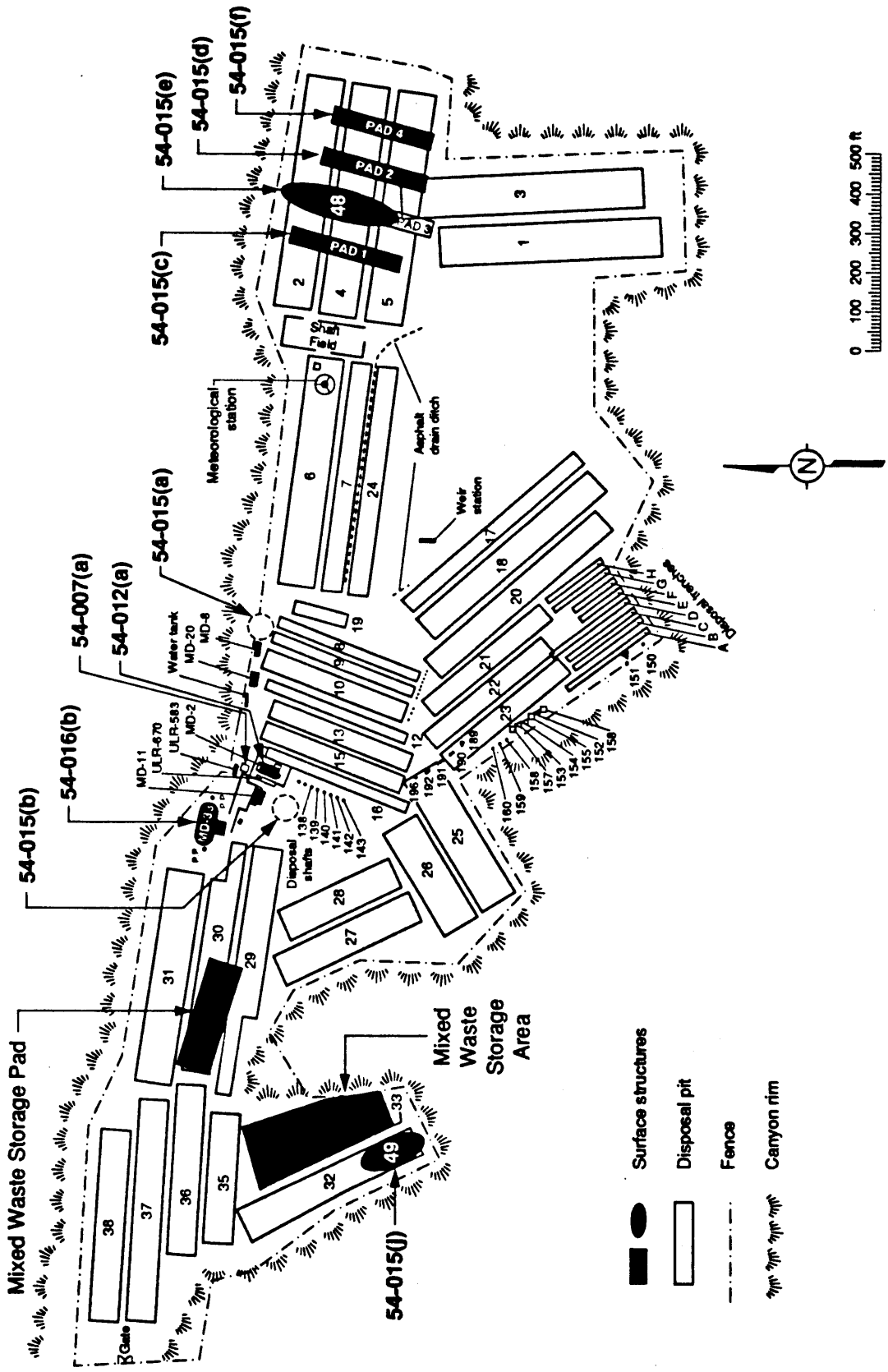


Figure 5.4-2 Location map of surface SWMUs at MDA G.

building) and TA-54-11 (the Waste Management Control Facility). This system generally receives sanitary wastes, but because it is located within MDA G, it may have received hazardous constituents. A compactor, SWMU 54-012(a), is located inside TA-54-2. This compactor was used to compact radioactive solid waste. Although there are no known releases from the compactor, the wastes compacted by SWMU 54-012(a) contain radionuclides; in previous years, hazardous constituents may have been present in the wastes. There are seven surface storage areas within MDA G. SWMU 54-015(a) is a TRU drum storage area at TA-54-8 where drums are stored on plywood inside a 15-ft by 40-ft by 12-ft high metal shed prior to being sprayed with a corrosion inhibitor. Stained soil was observed near 54-015(a) during a site visit. A second surface storage area, SWMU 54-015(b), is located approximately 100 ft southwest of TA-54-11. TRU waste is stored at this site in 20-year retrievable containers, and low-level waste is stored in dumpsters. Four TRU waste storage pads are located in the northwest corner of MDA G. Pad 1 [SWMU 54-015(c)], Pad 2 [SWMU 54-015(d)], and Pad 4 [SWMU 54-015(f)] each store six levels of retrievable contact-handled TRU waste in 55-gal drums. Pad 2 is completely filled and covered over with tuff; Pads 1 and 4 are partially filled and partially covered; and Pad 3 [SWMU 54-015(e)] is covered by a temporary dome structure (TA-54-48). Pad 3 is also used for contact-handled TRU waste storage. Storage began on Pads 1 through 4 in 1974. These pads overlie disposal Pits 2, 4, and 5 (SWMU 54-017). A second temporary dome structure (TA-54-49) is located on Pit 32 in the southeast section of MDA G. This dome is used as a storage area [SWMU 54-015(j)] for mixed waste sludge. No visible releases have been observed at SWMUs 54-015(b-f,j). A sump [SWMU 54-016(b)] is associated with TA-54-33. This sump is used to collect waste from the removal of the corrosion inhibitor that is sprayed on TRU waste drums. There is no documentation of a release from this sump.

5.4.1.2 Conceptual Exposure Model

5.4.1.2.1 Existing Information on Nature and Extent of Contamination

Archival data used to estimate source terms for MDA G constituents were compiled following review of interoffice memoranda, laboratory notebooks, logbooks, and other records maintained throughout the Laboratory (Rogers 1977, 0216). The following is a summary of existing information regarding the nature and extent of contamination at MDA G.

Beginning in 1971, new records management procedures were implemented at MDA G. The procedures required waste generators to complete Radioactive Solid Waste Disposal Record Forms, on which the waste volume, radionuclide inventory, matrix, and the disposal location were recorded. The waste information was reviewed by personnel within the EM-7 Group and entered into computer files which list the contents of each pit, shaft, and trench. This information was tabulated for ease of manipulation and to provide input data for TRACR3D, an environmental flow and transport model (Travis 1991, 0523). Although these data were considered the most comprehensive inventory of waste available, it is important to note that the waste description records do not necessarily represent actual measurements of the waste.

Waste inventory data, environmental monitoring results, horizontal borings specifications, and historic releases since 1977 were retrieved from several Laboratory reports (Purtymun el al. 1978, 0207; Purtymun et al. 1980, 0711). TA-50 Annual Reports provided process history for sludge waste (IT Corporation 1991, 08-0025). Descriptions of pit and shaft contents and summaries of disposal methods were obtained from the draft EM-7 Emergency Response Standard Operating Procedures (IT Corporation 1990, 08-0026). LANL EM-8 records provided results from vapor monitoring well studies (LANL 1990, 08-0048).

The inventories of individual pits and shafts are provided in Appendices 4-A and 4-B, respectively, of the Operable Unit 1148 Data Report (IT Corporation 1992, 08-0015). Individual inventories include closure dates, waste volume, and a brief description of waste forms present. Waste volume entries labeled "unknown" indicate that the constituent was reported on the Radioactive Solid Waste Disposal Record Form, but no amount was recorded. Likewise, entries of "chem," "asbestos," and "PCBs" indicate that unspecified amounts of those materials were present.

5.4.1.2.1.1 Radioactive Waste

Radioactive wastes stored or disposed of at MDA G were categorized as routine low-level radioactive waste, low-level mixed waste, TRU waste, tritium waste, Mixed Activation Products (MAP), Mixed Fission Products (MFP), radioactive animal tissue, radioactive asbestos waste, beryllium waste, or PCB waste (Rogers 1977, 0216; IT Corporation 1990, 08-0026). The following paragraphs define waste categories used by the Laboratory (indicated by underlined text) prior to issuance of DOE Order 5820.2A. Radioactive waste types, as defined in DOE Order 5820.2A, are designated with bold-face type (DOE 1988, 0074).

Routine Low-Level Radioactive Waste **(Low-Level Waste)** is defined as all solid radioactive wastes not otherwise categorized. These wastes, which are placed into pits, typically consist of a wide variety of radioactively-contaminated material or materials that are suspected to be radioactively contaminated based on the origin of their use. Examples of these waste types include cheesecloth, paper, metal, gloves, glassware, and other small laboratory items which were generated at the CMR Building at TA-3 and at TA-21 (Rogers 1977, 0216). Some materials may have undergone compaction before being placed in plastic bags, sealed with tape, and contained in 0.6 m^3 (2 ft^3) cardboard boxes. The boxes were labeled as containing radioactive or combustible waste, and may or may not have been monitored for radioactivity. Wastes generated at DP-West (TA-21) were monitored by the Multienergy Gamma Assay System (MEGAS), which detects X-ray and low-energy gamma emissions from materials with activity levels below 10 nCi/g. Routine low-level tritium waste is packaged in asphalt-lined 115- or 210-L drums.

Other routine low-level wastes might include contaminated oil absorbed into vermiculite and packaged in 115- or 210-L drums, contaminated chemicals that were neutralized and/or absorbed into some neutral material and packaged in metal containers, contaminated animal tissue, and contaminated classified material. Nonroutine wastes, such as large pieces of equipment and machinery or building debris generated during decontamination and decommissioning (D&D) projects,

may not have been packaged before disposal in the pits (Appendix F of Rogers 1977, 0216).

Routine waste that contained transuranium elements too low in activity to be classified as TRU waste was separated into retrievable or nonretrievable waste and packaged. Retrievable transuranium waste was generated at TA-55, DP-West (TA-21), the CMR Building (TA-3), and the Liquid Waste Treatment Plants at TA-21 and TA-50. This waste consisted of ^{238}Pu- and ^{239}Pu-contaminated residues and trash, $^{239}Pu/^{241}Am$-contaminated cement waste, dewatered sludge, and gloveboxes, hoods, and equipment from processing and research and development (R&D) areas. Much of this waste is packaged in Department of Transportation (DOT)-type 17C 55-gal drums.

The major source of routine nonretrievable transuranium waste is the product of liquid radioactive waste treatment. Dewatered sludge from the Liquid Waste Treatment Plant at TA-50 is batch assayed to determine whether it will be designated as retrievable or nonretrievable. Nonretrievable material is packaged in 5 mil plastic-lined 210-L (55-gal) mild steel drums. Occasionally, waste with levels greater than 1 rem/hr is disposed of in pits if shielding prevents personnel exposure to levels higher than those from routine low-level waste (IT Corporation 1990, 08-0026). Terminology used in historic Laboratory records prior to DOE Order 5820.2A have been retained here to preserve continuity in descriptions of existing archival information.

Low-Level Mixed Waste **(Mixed Waste)** is defined as a radioactive waste that is also RCRA-hazardous according to 40 CFR 261. In MDA G, the majority of mixed low-level waste is considered as such because it contains lead or cadmium or traces of organic compounds. Low-level mixed wastes are stored in the Mixed Waste Dome (Building TA-54-49), and include potentially ignitable nitrated rags, and uranium chips and turnings (IT Corporation 1990, 08-0026). According to DOE Order 5820.2A, test specimens containing fissionable material irradiated for the purpose of research only (not for the production of power or plutonium) may be classified as low-level wastes, provided the concentration of transuranium radionuclides is less than 100 nCi/g of waste.

TRU Waste **(Transuranic Waste)** is defined as alpha-emitting radionuclides with half-lives greater than 20 years and present in concentrations greater than 100 nCi/g of waste (DOE 1988, 0074). Natural and depleted uranium are excluded from this category. Mixed TRU waste is TRU waste that contains constituents such as lead, chromium, cadmium, arsenic, and trace organic compounds in sufficient concentrations to make the waste RCRA-hazardous per 40 CFR 261. Some TRU waste is stored in the TRU Waste Dome (TA-54-48) on Pad 3 until it can be shipped to a waste repository (Figure 5.4-2). Other TRU waste is in long-term retrievable storage. TRU waste for which a dose rate is measured below 200 mrem/hr at the surface of the container is considered **Contact-Handled Transuranic Waste**. At MDA G, there is a limited amount of TRU waste that exceeds the 200 mrem/hr surface dose rate and that is designated as Remote-Handled Transuranic Waste.

Tritium waste is not a uniquely defined waste under DOE Order 5820.2A, but is considered low-level waste. Routine low-level tritium waste is defined in Laboratory records as waste containing less than 20 mCi/m^3. It is disposed of as routine low-

level waste. Intermediate-level tritium waste contains between 20 mCi/m^3 and 100 Ci/m^3. It is packaged in asphalt-lined drums and placed in unlined Shafts 136 or 137 (Figure 5.4-1). High-level tritium waste, above 100 Ci/m^3, is packaged in 30-gal drums, overpacked in 55-gal drums lined with asphalt, and disposed of in lined Shafts 158 or 159 (Figure 5.4-1) (IT Corporation 1990, 08-0026).

MFP, MAP, and Source Wastes, which are disposed of in shafts, typically have dose rates exceeding 1 rem/hr. MFP, MAP and Source Wastes are not uniquely defined under DOE Order 5820.2A. MFP waste is generated in hot-cell operations, and MAP waste is generated in irradiation studies, including those conducted at the Meson Physics Facility. Any MAP or MFP wastes that do not exceed the 1 rem/hr level may be placed in a pit as routine low-level radioactive waste. Nonroutine MAP and MFP waste is placed in Shaft 141, with the exception of Meson Physics Facility waste, which is placed in Shafts 38, 124, 131, and 196 (Figure 5.4-1). Source waste is placed in Shaft 22 (Figure 5.4-1). The radiation levels for these waste forms are generally well above 1 rem/hr (IT Corporation 1990, 08-0026).

Radioactive animal tissues may contain a wide variety of isotopes, but are expected to contain relatively low activities of isotopes from any other categories defined here. There is no unique definition of radioactive animal tissue under DOE Order 5820.2A.

Radioactive asbestos wastes are placed into Pit 31, which is dedicated to asbestos disposal; however, asbestos has been reportedly disposed of in other pits and shafts at MDA G. There is no unique definition of radioactive asbestos waste under DOE Order 5820.2A.

Laboratory records indicate that a variety of radioactive wastes were received at MDA G (Table 5.4-1). Over time, radionuclides with short half-lives decay, contributing less to the total radioactivity in a pit than radionuclides with long half-lives. For this reason, radionuclides with half-lives shorter than 5 years will not be used in environmental transport calculations for future modeling (Table 5.4-2). Inert gases (specifically ^{85}Kr) were also excluded.

An isotope was not omitted if it was determined to have a daughter with a long half-life. For instance, ^{249}Cf has ^{245}Cm as a daughter with a half-life longer than 5 yr; likewise, ^{252}Cf has ^{248}Cm and ^{244}Pu; ^{152}Eu has ^{152}Gd; and ^{147}Pm has ^{147}Sm.

Although ^{210}Po is the daughter of a long-lived parent, ^{210}Pb, there is no record of ^{210}Pb disposal at MDA G. If ^{210}Po is present as a ^{210}Pb daughter, then both ^{210}Pb and ^{210}Po should be included in radionuclide transport calculations. If, however, ^{210}Po was isolated from ^{210}Pb elsewhere, and used in pure form at the Laboratory, then both ^{210}Pb and ^{210}Po can be excluded. Until the origin of ^{210}Po and ^{210}Pb at MDA G can be determined, both ^{210}Pb and ^{210}Po will be considered in future environmental transport calculations.

MFPs result from fission of ^{232}Th, ^{233}U, ^{235}U, ^{236}U, ^{238}U, ^{237}Np, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, and ^{252}Cf. Information regarding the nature of the fissile material used to generate the MFP or the neutron energy spectrum has not been recorded in the Radioactive Solid Waste Disposal Record Forms. However, it is possible to estimate the fission product distributions from tabulated fission product mass chains and the

TABLE 5.4-1
RADIONUCLIDES REPORTED IN MDA G
ACCORDING TO LANL RADIOACTIVE SOLID WASTE DISPOSAL FORMS

^{3}H, ^{7}Be, ^{10}Be, ^{14}C, ^{22}Na, ^{32}P, ^{35}S, ^{36}Cl, ^{46}Sc, ^{48}V, ^{51}Cr, ^{54}Mn, ^{55}Fe, ^{59}Fe, ^{56}Co, ^{57}Co, ^{58}Co, ^{60}Co, ^{63}Ni, ^{65}Zn, ^{75}Se, ^{82}Br, ^{85}Kr, ^{82}Sr, ^{89}Sr, ^{90}Sr, ^{88}Y, ^{90}Y, ^{95}Zr, ^{94}Nb, ^{99}Tc, ^{99m}Tc, ^{103}Ru, ^{106}Ru, ^{110}Ag, ^{109}Cd, ^{125}I, ^{131}I, ^{134}Cs, ^{137}Cs, ^{139}Ba, ^{140}Ba, ^{152}Eu, ^{182}Ta, ^{144}Ce, ^{147}Pm, ^{192}Ir, ^{203}Hg, ^{210}Po, ^{226}Ra, ^{228}Ra, ^{227}Ac, ^{228}Th, ^{229}Th, ^{230}Th, ^{232}Th, ^{231}Pa, ^{232}U, ^{233}U, ^{234}U, ^{235}U, ^{236}U, ^{238}U, ^{237}Np, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, ^{241}Am, ^{243}Am, ^{244}Cm, ^{249}Cf, ^{252}Cf.
Mixed Fission Products (MFP).
Mixed Activation Products (MAP).

TABLE 5.4-2
RADIONUCLIDES TO BE EXCLUDED
FROM ENVIRONMENTAL TRANSPORT CALCULATIONS

The following isotopes have half lives shorter than 5 years:

^{7}Be, ^{22}Na, ^{32}P, ^{35}S, ^{46}Sc, ^{48}V, ^{51}Cr, ^{54}Mn, ^{55}Fe, ^{59}Fe, ^{56}Co, ^{57}Co, ^{58}Co, ^{65}Zn, ^{75}Se, ^{82}Br, ^{82}Sr, ^{89}Sr, ^{88}Y, ^{90}Y, ^{99m}Tc, ^{103}Ru, ^{106}Ru, ^{110}Ag, ^{109}Cd, ^{125}I, ^{131}I, ^{134}Cs, ^{139}Ba, ^{140}Ba, ^{144}Ce, ^{147}Pm, ^{182}Ta, ^{192}Ir, ^{203}Hg, and ^{228}Th.

Krypton-85 is an inert gas.

decay chains for the fission products [Appendix 4-C of the Operable Unit 1148 Data Report (IT Corporation 1992, 08-0015)]. It can be shown that >99% of the radioactivity in MFP is contained in six isotopes, such that

$$1\ Ci\ MFP = 0.56Ci\ ^{90}Sr + 0.37Ci\ ^{137}Cs + 0.031Ci\ ^{152}Eu +$$

$$0.015Ci\ ^{154}Eu + 0.011Ci\ ^{155}Eu.$$

MAP composition is more difficult to estimate than MFP composition. MAPs result from neutron bombardment of a wide variety of materials. The activation product composition is highly dependent on the neutron capture cross section of the target materials, the neutron energy spectrum, and the duration of bombardment. As a result, the composition of MAP activity given in the Radioactive Solid Waste Disposal Record Forms must be estimated from the specific reactions that produced the waste. This information is not currently available; however, some assumptions can be made to reduce uncertainties. MAPs are expected to include ^{7}Be, ^{22}Na, ^{46}Sc, ^{48}V, ^{51}Cr, ^{52}Mn, ^{54}Mn, ^{59}Fe, ^{56}Co, ^{57}Co, ^{58}Co, ^{60}Co, ^{56}Ni, ^{65}Zn, ^{152}Eu, and ^{154}Eu. Of these isotopes, only ^{60}Co (half-life = 5.26 yr), ^{152}Eu (half-life = 12.7 yr), and ^{154}Eu (half-life = 8.58 yr) are expected to be important (IT Corporation 1991, 08-0017). If it is assumed that the three isotopes were created in equal mass amounts, then

$$1Ci\ MAP = 0.74Ci\ ^{60}Co + 0.14Ci\ ^{154}Eu + 0.12Ci\ ^{152}Eu.$$

The radionuclides at MDA G selected for future environmental transport calculations are listed in Table 5.4-3.

Except for the exclusion from the waste inventory of radionuclides with half-lives less than 5 years, corrections for decay of radionuclides after disposal, or determinations as to whether secular equilibrium might exist for decay chains were not performed. These calculations will be made in the TRACR3D transport model.

5.4.1.2.1.2 Nonradioactive Waste

Nonradioactive wastes present at MDA G are summarized in Table 5.4-4. PCBs and asbestos are regulated under TSCA. RCRA-regulated constituents include beryllium, barium, cadmium, selenium, silver, lead, chromium, mercury, arsenic, and volatile organic compounds (VOCs).

Nonradioactive and Radioactive Beryllium Waste consists of nonradioactive beryllium-contaminated soil and beryllium-contaminated pump oil. Beryllium residues may be also be included in wastes from D&D activities at former firing sites. Radioactive beryllium is defined as **low-level waste** under DOE Order 5820.2A.

PCB Waste may include contaminated transformer hardware or contaminated soil. PCBs are regulated under TSCA. MDA G is permitted by the EPA for disposal of solid waste containing PCBs. If the concentration of PCBs in the waste is below 500 ppm, the waste is placed into an active pit; if it is over 500 ppm, the waste is placed into Shaft C-13 (Figure 5.4-1) (IT Corporation 1990, 08-0026). Although Pit 31 is designated as an asbestos pit, asbestos might be present in any pit at MDA G that was active prior to RCRA regulations.

TABLE 5.4-3
RADIONUCLIDES AT MDA G SELECTED FOR ENVIRONMENTAL TRANSPORT CALCULATIONS

^{3}H, ^{10}Be, ^{14}C, ^{36}Cl, ^{60}Co, ^{63}Ni, ^{90}Sr, ^{95}Zr, ^{94}Nb, ^{99}Tc, ^{137}Cs, ^{147}Sm, ^{152}Eu, ^{152}Gd, ^{154}Eu, ^{210}Pb, ^{210}Po, ^{226}Ra, ^{227}Ac, ^{228}Ra, ^{229}Th, ^{230}Th, ^{232}Th, ^{231}Pa, ^{232}U, ^{233}U, ^{234}U, ^{235}U, ^{236}U, ^{238}U, ^{237}Np, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, ^{244}Pu, ^{241}Am, ^{243}Am, ^{248}Cm, ^{244}Cm, ^{245}Cm, ^{249}Cf, and ^{252}Cf.

TABLE 5.4-4
MDA G CONSTITUENTS REGULATED UNDER PROPOSED RCRA SUBPART S OR TSCA

Constituent	Location
PCBs	Pits 28, 32, 36 Shaft C1-C13 (oil)
Beryllium	Pit 36 Shafts 6, 7, 61 Contaminated vacuum-pump oil in Shafts 8, 10, 32, 39, 40, 45, 58, 61, 62, 79
Asbestos	Pits 31, 19, 26, 35
Metals (unspecified)	Shafts 3, 4, 5, 25, 26, 42, 47, 61
Shielding Blocks (possibly lead)	Shafts 114, 120
VOCs	Shaft 124

5.4.1.2.1.3 Inventory of Disposal Pits

The inventories of disposal pits, tabulated by EM-7, are described in detail in Appendix 4-A of the Operable Unit 1148 Data Report (IT Corporation 1992, 08-0015). Periods of operation for MDA G disposal pits by SWMU Groups (see Section 5.4.2.1.1) are summarized in Tables 5.4-5 through 5.4-10, as well as in the OU 1148 Data Report. The locations of disposal pits within MDA G are shown on Figure 5.4-1.

Pits 5, 8, 10, 20, and 22 contain sludges produced in the dewatering facility at TA-50. These wastes may include constituents that have the potential to migrate from the pit. Pit 10 (Figure 5.4-1) contains the largest inventory of MAPs (756 Ci).

Pits 7, 12, and 17 (Figure 5.4-1) contain low-activity transuranium radionuclide waste, but the inventory of Pit 17 is largely unknown. Pit 31 was dedicated to asbestos disposal, although many of the pits that contain mixed waste also include asbestos.

Most of the pits contain radionuclides mixed with RCRA hazardous constituents. Because the Radioactive Solid Waste Disposal Record Forms were used to record only the radionuclides in the waste, there is little information concerning the identities or amounts of organic chemicals and metals present. The mixed waste pits contain the largest inventory of tritium (1,350 Ci in Pits 25, 27, and 28), ^{137}Cs (200 Ci in Pit 25), ^{60}Co (120 Ci in Pit 25), MFP (12.5 Ci in Pit 33), and ^{99}Tc (5,280 Ci in Pit 37) (Operable Unit 1148 Data Report, IT Corporation 1992, 08-0015)

For purposes of this Work Plan, each disposal pit at MDA G was assigned to one of three priority categories based on existing archival information (Table 5.4-11). The higher priority categories include pits that will be given greatest attention in the future.

The priority categories are defined as:

High Priority - This category includes pits containing wastes with largely unknown activities, or those which contain waste with a known activity of greater than 100 Ci for a single contaminant. This category also includes pits with completely unknown contents.

The following pits are high priority: 1 through 6, 10, 17 through 19, 25, 27, 28, and 37 (Figure 5.4-1).

Medium Priority - This category includes pits containing wastes with activities which are at least 50 percent known, with no individual contaminant exceeding 100 Ci.

The following pits are medium priority: 7, 8, 12, 13, 16, 20, and 21 (Figure 5.4-1).

Low Priority - This category includes pits containing wastes with activities which are at least 75 percent known, with no individual contaminant exceeding 20 Ci.

TABLE 5.4-5
SWMU GROUP 54-a: DISPOSAL SITES CLOSED BEFORE NOVEMBER 19, 1980
(SWMUs 54-017 AND 54-019)

Potential Release Site	Unit Number	Inclusive Operation Dates[a]
Pits	1-8, 10, 12, 13, 16-22, 24	1/59 - 3/80
Shafts	1-20, 24-34, 38-92, 96, 109-112, 150	4/66 - 7/80

[a]Shaft 38 received a final delivery of waste on 2/1/74, but has not been capped to date.

TABLE 5.4-6
SWMU GROUP 54-b: DISPOSAL SITES CLOSED BEFORE JULY 26, 1982
(SWMUs 54-018 AND 54-020)

Potential Release Site	Unit Number	Inclusive Operation Dates[a]
Pits	25	1/80 - 5/81
Shafts	101, 106-108 C1 - C7	9/80 - 5/82 Capped 2/81

[a]The operation dates of PCB waste Shafts C1 - C7 are unknown, but they were capped in 2/81.

TABLE 5.4-7
SWMU GROUP 54-c: DISPOSAL SITES OPERATED AFTER JULY 26, 1982, AND BEFORE MAY 1, 1985 (SWMUs 54-018 AND 54-020)

Potential Release Site	Unit Number	Inclusive Operation Dates[a]
Pits	26-29, 33	5/81 - 10/86
Shafts	35-37, 93-95, 97, 99, 100, 102-105, 114, 115, 118-123, 125-127, 151-154, 190, 191	6/70 - 7/87
	C8 - C10	Capped 1984 - 1985

[a]The operation dates of Shaft 98 are unknown, but it is recorded as capped. The operation dates of PCB waste Shafts C8 - C10 are unknown, but they were capped in 1984 - 1985.

TABLE 5.4-8
SWMU GROUP 54-d: DISPOSAL SITES OPERATED
AFTER MAY 1, 1985, AND BEFORE SEPTEMBER 26, 1988
(SWMUs 54-018 AND 54-020)

Potential Release Site	Unit Number	Inclusive Operation Dates[a]
Pits	32, 35, 36	11/85 - 12/88
Shafts	124, 128-136, 138-140, 155-157, 189, 192 C12 - C13	10/85 - 5/90

[a]Shaft 124 received a final delivery of waste on 7/87, but has not been capped to date.
Shaft 131 received a final delivery of waste on 7/88, but has not been capped to date.
Shaft 132 received a final delivery of waste on 8/88, but has not been capped to date.
Shaft 136 received a final delivery of waste on 5/87, but has not been capped to date.
Shaft 140 received a final delivery of waste on 8/89, but has not been capped to date.
PCB Shaft C13 received a final delivery of waste on 5/90, but has not been capped to date.

TABLE 5.4-9
SWMU GROUP 54-e: DISPOSAL SITES OPERATED
AFTER SEPTEMBER 26, 1988
(SWMUs 54-018 AND 54-020)

Potential Release Site	Unit Number	Inclusive Operation Dates[a]
Pits	30, 31, 37	10/88 - In Use
Shafts	22, 158-160, 196	6/89 - 9/89

[a]The operate dates of Shafts 21 and 23 are unknown, but they are recorded as open.
Shaft 158 received the only delivery of waste in 9/89, but has not been capped to date.
Shaft 159 received the only delivery of waste in 4/89, but has not been capped to date.
The operation dates of Shaft 160 are unknown, but records indicate that it contains 0.1 of tritium (IT Corporation 1991, 08-0024)
Shaft 196 received a final delivery of waste in 8/89, but has not been capped to date.
Pits 11, 14, 15, 23, and 34 were never excavated.
Shafts 142 - 149 are unused.
Numbers 113, 116, 117, 161 - 188, and 193 - 195 have not been assigned to shafts.

TABLE 5.4-10
SWMU GROUP 54-f: DISPOSAL PITS AND SHAFTS NOT ASSIGNABLE TO PREVIOUS GROUPS

Unit Type	Status
Pits	
11, 14, 15, 23, and 34	Never excavated
Shafts	
21, 23, 98, 137, 160, C11	Operation date unknown
142-149	Unused
113, 116, 117, 161-168, 193-195	Numbers have not been assigned to any shaft

The final waste delivery date at Shaft 137 is unknown, but the shaft has not been capped to date.
The operation dates of PCB Shaft C11 are unknown, but it has been recorded as capped.

TABLE 5.4-11
MDA G DISPOSAL PIT PRIORITY

Pit No.	Priority[a]	Data Status
1	1	All Activities Unknown
2	1	No Data Available
3	1	All Activities Unknown
4	1	No Data Available
5	1	High Activity of ^{238}Pu (261 Ci)
6	1	Most Activities Unknown
7	2	At least 50 percent of Activities Known
8	2	At least 50 percent of Activities Known
9	2	At least 50 percent of Activities Known
10	1	High Activity of ^{3}H (6,050 Ci)
12	2	At least 50 percent of Activities Known
13	2	At least 50 percent of Activities Known
16	2	At least 50 percent of Activities Known
17	1	All Activities Unknown
18	1	High Activity of ^{60}Co, ^{90}Sr
19	1	Most Activities Unknown
20	2	At least 50 percent of Activities Known
21	2	At least 50 percent of Activities Known
22	3	At least 75 percent of Activities Known
24	3	At least 75 percent of Activities Known
25	1	High Pit Activity
26	3	At least 75 percent of Activities Known
27	1	High Activity of ^{3}H (106 Ci)
28	1	High Activity of ^{3}H (1,200 Ci)
29	3	At least 75 percent of Activities Known
30	3	At least 75 percent of Activities Known
31	3	At least 75 percent of Activities Known
32	3	At least 75 percent of Activities Known
33	3	At least 75 percent of Activities Known
35	3	At least 75 percent of Activities Known
36	3	At least 75 percent of Activities Known
37	1	High Activity of ^{99}Tc

[a]Criteria for priorities are described in Section 5.4.1.2.1.3:
1 - high priority
2 - medium priority
3 - low priority

The following pits are low priority: 22 through 24, 26, 29 through 33, 35, and 36 (Figure 5.4-1).

5.4.1.2.1.4 Inventory of Disposal Shafts

The inventories of disposal shafts, tabulated by EM-7, are described in detail in Appendix 4-B of the Operable Unit 1148 Data Report (IT Corporation 1992, 08-0015). Periods of operation for MDA G disposal shafts by SWMU Groups (see Section 5.4.2.1.1) are summarized in Tables 5.4-5 through 5.4-10, as well as in the OU 1148 Data Report. The locations of disposal shafts within MDA G are shown on Figure 5.4-1.

Two disposal shafts (98 and 133) were designed to contain waste with higher activities of radioactivity and isotopes that emit penetrating radiation (Figure 5.4-1). The inventory of Shaft 98 is entirely unknown, and Shaft 133 contains 3,080 Ci of MAPs.

Three shafts (14, 19, and 70) contain sludges that may potentially include mobile radionuclides in the form of HCl neutralized with NaOH (Figure 5.4-1).

Shafts containing mixed waste may contain any of the isotopes stored in other shafts, but are usually mixed with unspecified chemical wastes. The chemical wastes which have been identified at MDA G include: beryllium, herbicides (Shaft 35), HF leachates, hydrocarbons, and PCB oil. Shaft 123, which contains small amounts of depleted uranium, might be considered a low-activity shaft; however, it contains firing residues that might include explosives residues.

Tritium wastes represent the second highest levels of radioactivity in MDA G, and the most mobile radionuclide. Shafts 15, 16, 50, 152, 153, and 155 through 158 contain >10,000 Ci, and shafts 150, 151, and 154 contain >100,000 Ci. The chemical form of the tritium is not reported, although it is reported to be sorbed onto vermiculite or other solids. It is assumed that tritium is bound to organic compounds or water.

Shafts C1 through C13 contain PCB-contaminated oil and, except for Shaft C-10 (which contains an unknown amount of ^{239}Pu), contain no radiological constituents.

Each disposal shaft was assigned to one of the three priority categories based on the status of existing information (Table 5.4-12). The higher priority category includes shafts that will be given greatest attention in the future.

The priority categories are defined as:

High Priority - This category includes shafts containing wastes with largely unknown activities, or those which contain waste with a known activity greater than 150 Ci for a single contaminant. The key contaminants are ^{3}H, ^{60}Co, ^{90}Sr, MAP, and MFP. This category also includes shafts for which the contents are completely unknown.

TABLE 5.4-12
TA-54 MDA G DISPOSAL SHAFT PRIORITY

Data Status	Shaft Number
High Priority	
High ^{3}H	6, 7, 15, 16, 39, 50, 59, 61, 136, 137, 150-159.
Unknown ^{3}H Inventory	3, 4, 8-11, 22, 30, 32, 60, 81, 104, 121, 132.
High ^{60}Co	22, 23, 97, 102, 108, 122.
Unknown ^{60}Co Inventory	95, 128.
High MAP/MFP1, 2, 28, 58, 94, 98, 100,	107, 110, 114, 120, 126, 139, 141, 189-192, 196.
Generally Unknown Values of Radionuclides	34, 37, 39, 56, 57, 70, 82, 84, 85, 118, 135, 138, 140.
Generally High Activity of Radionuclides	129, 133.
Medium Priority	
Generally Unknown Activity (< 150 Ci)	12, 13, 14, 24, 25, 27, 36, 40 -42, 45, 47, 52-55, 68, 69, 72, 74, 75, 77, 78, 79, 80, 83, 87, 93, 103, 106, 112, 115, 124, 134.
Low Priority	
Activity Generally Known (< 20 Ci)	5, 17-21, 26, 29, 31, 33, 35, 38, 43, 44, 46, 48, 49, 51, 62-67, 71, 76, 86, 88-92, 96, 99, 101,105, 109, 111, 119, 123, 125, 127, 130, 131, 160, 206
PCB-Contaminated Oil	C1-C13

Medium Priority - This category includes shafts containing wastes with several unknown activities (unknown key contaminants are high priority), with no individual contaminant exceeding 150 Ci.

Low Priority - This category includes shafts containing wastes with activities which are mostly known, with no individual contaminant exceeding 20 Ci.

5.4.1.2.1.5 Potential Vapor Waste Forms

The occurrence of VOCs has been previously reported in MDA G pits and shafts. Monitoring programs have detected 2-butanone, chloroform, toluene, xylenes, and bis-(2-ethylhexyl) phthalate in soil sediments (IT Corporation 1987, 0327). These compounds have the potential to volatilize and migrate in the subsurface in unsaturated tuff.

5.4.1.2.1.6 Potential Aqueous Waste Forms

The potential dispersion of MDA G constituents through air and water will be modeled using TRACR3D. Input data to TRACR3D requires information on the various chemical forms of each constituent. Some of the wastes at MDA G are in the form of sludges treated at the TA-50 Wastewater Treatment Facility. Generally, the liquid wastes were solidified with lime and ferrous sulfate, and although most of the water was removed, it is likely that the sludges contain water soluble species. The ionic species of each metal that might be formed in equilibrium with either rainwater or ground water can be calculated using the geochemical model EQ3 VI. Therefore, the importance of dissolved radionuclide species to the TRACR3D modeling effort was investigated by applying a standard geochemical model to a representative pit (Pit 22) [Appendix 3.4-D of the Operable Unit 1148 Data Report (IT Corporation 1992, 08-0015)].

Geochemical modeling results show that aqueous concentrations of Am, Np, Pu, Sr, Th, and U are limited by their solubility, indicating that the total inventory is not a critical parameter of the waste as long as a sufficient quantity is present in the pit to reach the solubility limit. That is, a doubling of the inventory will not double the potential dose to a receptor. Modeling results for other waste elements, such as Co, Cs, and tritium, show that the entire inventories were soluble in a single liter of water; therefore, the predicted concentrations of these elements are directly proportional to their inventories. Alternative methods of source term estimation, such as the EPA 70-year rule, may be used for these inventory-limited elements (EPA 1988, 0594).

5.4.1.2.1.7 Historical Releases

Historical releases which have occurred at TA-54, MDA G, are summarized in this section. Additional detail may be found in the following Laboratory reports: Rogers 1977, 0216 and LANL 1990, 0145. Refer to Figure 5.4-1 for a location map of the pits, shafts, and trenches in MDA G, and to Figure 5.4-2 for the location of surface SWMUs in MDA G.

Three fires occurred at MDA G between 1960 and 1976. One fire, which occurred on September 16, 1960, in Pit 1, burned most of the exposed waste before it was discovered (Rogers 1977, 0216). A second fire was reported on November 21, 1964, in Pit 3, and resulted in burned boxes and detectable alpha activity in the smoke. On April 14, 1976, a flame several feet high was observed in Pit 24 for several seconds, but no contamination from the burning waste was detectable (Rogers 1977, 0216).

A drum ruptured while workers were attempting to recover a pump in Pit 6 and, as a result, three trucks and three dumpsters were contaminated. Because of this incident, a request for a decontamination (truck washing) pit was made, and Pit 19 was excavated in April of 1971. Pit 19 first began receiving waste under its new use definition as a decontamination pit on November 21, 1975 (Rogers 1977, 0216). Due to limited archival information, the extent of releases at the truck washing (decontamination) pit, SWMU 54-013(b), is unknown.

During a visual site inspection, stains were reported on soil at TA-54-8, which is a drum storage area [SWMU 54-015(a)] where TRU drums are stored prior to being sprayed with a corrosion inhibitor.

Surface contamination by ^{238}Pu and ^{239}Pu has been reported around the disposal pits (SWMUs 54-017 and 54-018), and around the disposal shafts (SWMUs 54-019 and 54-020). This surface contamination may have resulted from fires caused by mixing incompatible wastes or from releases from vehicles hauling wastes to the pits and shafts (LANL 1990, 0145).

5.4.1.2.1.8 Environmental Monitoring Data

Tritium

Migration of tritium in the MDA G shaft disposal area was first detected on July 7, 1970. Samples of tuff collected during augering of Shafts 40 through 49 were analyzed for moisture content and tritium content in moisture. The moisture content of the tuff ranged from 0.1 to 6.4 percent and averaged 1.2 percent by volume. Tritium concentrations collected from Shaft 34 in November 1969 ranged from 64 to 454 pCi/ml of soil moisture (Rogers 1977, 0216). Samples from Shafts 35 through 38 contained tritium concentrations ranging from 0 to 106 pCi/ml (Rogers 1977, 0216). Higher tritium concentrations (630 to 1180 pCi/ml of soil moisture) were found in samples from Shafts 39 through 48 (Rogers 1977, 0216). The low moisture content of the tuff indicates that the tritium was being distributed through the pore space of the tuff and through diffusion in water vapor.

Monitoring conducted approximately four years after wastes were stored in Shafts 12 and 13 indicated that tritium at concentrations of 100 pCi/ml had moved a distance of about 105 ft west of the shafts along the contact between two ash flows. The 100 pCi/ml contour was extrapolated beneath the shafts to a depth of about 97 ft below the surface of the mesa. The volume of tuff containing the tritiated moisture had assumed the shape of an irregular lens, shortened to the east and elongated to the west (Figure 5.4-3) (Rogers 1977, 0216).

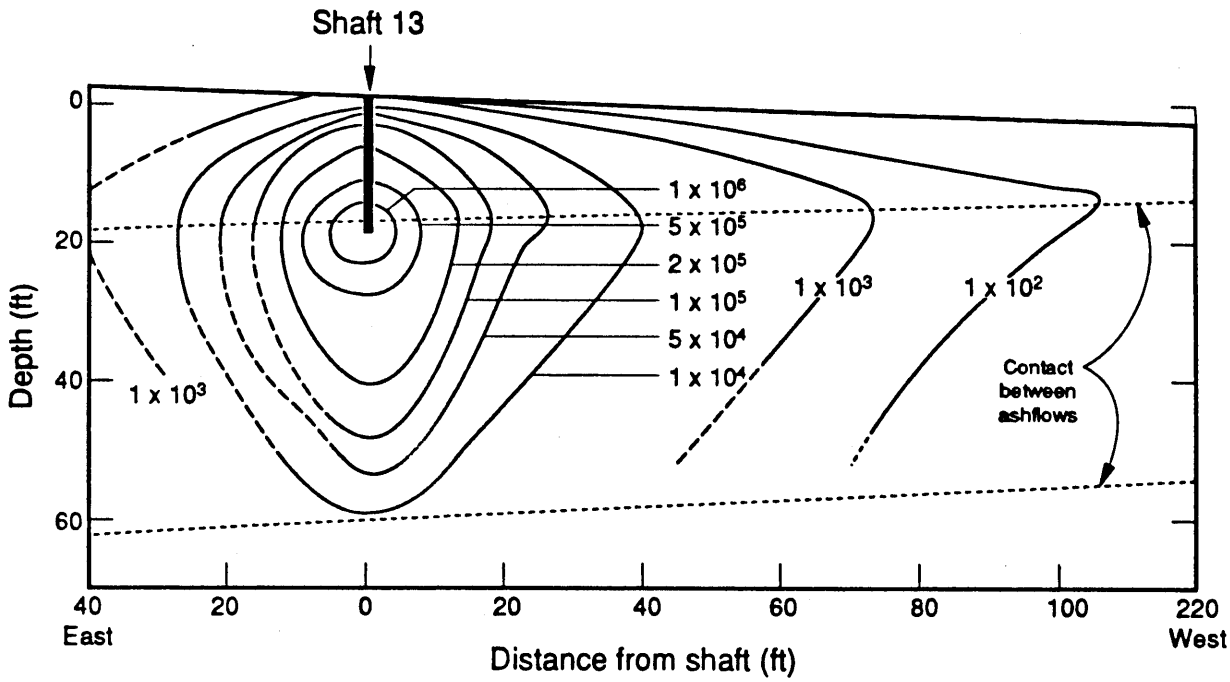


Figure 5.4-3 Isotritium concentrations found during the 1970 tritium migration study at MDA G (Rogers 1977 0216). Isotritium contours represent picocuries per milliliter (pCi/ml) of moisture.

Recorded tritium concentrations around Pit 1 at MDA G were as large as three orders of magnitude greater than the average measured background concentrations of 10-20 pCi/ml for both solid and near-surface tuff. The significant concentration gradient towards the surface indicates that tritium was diffusing towards and perhaps out of the ground surface (Rogers 1977, 0216). The Sampling and Analysis Plans (SAPs) developed for MDA G include soil sampling at the locations of these pits and shafts (refer to Section 5.4.4.7).

Other Radionuclides

Thirteen years after waste was initially stored in Pit 3, five horizontal holes were drilled under Pit 3 within approximately 0 to 25 ft beneath the floor of the pit (Purtymun et al. 1978, 0207). In order to determine the extent of radionuclide release from the pit and migration through the surrounding tuff, cores were obtained for radiochemical analysis of gross alpha and gross beta radioactivity and total uranium, as well as isotopic analysis of ^{90}Sr, ^{137}Cs, ^{238}Pu, $^{239,240}Pu$, and ^{241}Am (Purtymun et al. 1980, 0711). None of these radionuclides was found to be present in core samples above analytical detection limits, indicating that appreciable migration of these radionuclides has not occurred. No measurements of tritium were made.

Organic Constituents

In 1985, two vertical boreholes (designated as LGC-85-09 and LGC-85-10) were used to characterize vapor phase contaminants (Becker 1980, 0027). The results of analysis of pore gas samples indicate that trichloroethane (TCA) is the major constituent in vapor, and that trichloroethylene (TCE), perchloroethylene (PCE), chloroform, toluene, and trichlorofluoromethane (Freon-11) were found. TCA concentrations exceeded concentrations of other vapors by approximately 3 orders of magnitude, and ranged from nondetectable to concentrations of 980 $\mu g/L^3$.

Environmental Monitoring Beyond MDA G Boundary

In accordance with DOE Order 5400.1, the Laboratory routinely conducts environmental surveillance and publishes annual reports of sampling data. In 1982, nine sampling stations were established in the canyons adjacent to MDA G to monitor possible transport of radionuclides by storm runoff from the waste storage and disposal area (Figures 5.4-1 and 5.4-2). Sampling results indicate that some radionuclides were transported from the surface at MDA G in suspended sediments. This remnant contamination reportedly resulted from the handling of waste during emplacement. Total uranium in stream bed sediments at Station 5 was slightly above the background level of 4.4 µCi/g background (4.6 µCi/g). Plutonium-238 was present at Station 7 (0.026 pCi/g) and Station 9 (0.011 pCi/g) at levels exceeding background (0.006 pCi/g). Plutonium-239 and plutonium-240 exceeded background (0.023 pCi/g) at Station 9 (0.150 pCi/g). Tritium, cesium, and gross gamma were measured near or below background levels. Radionuclides in sediments from MDA G are not detectable at the Laboratory boundary at State Road 4 (LANL 1990, 0497).

Samples of stream bed sediments were collected from 9 sediment stations around MDA G and were analyzed for 65 VOCs, 68 semivolatile organic compounds (SVOCs), 22 pesticides, 3 herbicides, and mixed PCBs (LANL 1990, 0497). Volatile organic compound analysis reported 2-butanone at all sampling stations at concentrations ranging from 590-3500 µg/kg. Chloroform was reported at Stations 1, 2, 3, 4, and 8 at concentrations ranging from 520 to 650 µg/kg. Toluene was reported at all stations at concentrations ranging from 980 to 1400 µg/kg. The compound m-xylene was reported at stations 3, 4, and 8 at concentrations ranging from 500 to 520 µg/kg. 2-Butanone and toluene were present due to contamination of the sample during analysis. Since concentrations of chloroform and m-xylene were near detection levels, their presence cannot be confirmed. Semivolatile organic compound analysis reported benzoic acid at a concentration of 6500 µg/kg at Station 1. Sediments from Station 8 contained bis (2-ethylhexyl) phthalate at a concentration of 370 µg/kg, which is near the detection limit of 330 µg/kg.

5.4.1.2.2 Potential Pathways of Contaminant Migration

Figure 5.4-4 is a flow chart illustrating the conceptual site model showing the potential constituent pathways from sources to receptors. The sequence includes sources at MDA G, their associated release mechanisms, transport pathways, and potential modes of receptor exposure. The four primary sources at MDA G are pits, shafts, trenches, and surface storage areas. The primary release mechanism in the conceptual model is considered to be loss of containment, which could result from loss of containment of stored waste or from waste management activities.

The following transport pathways have been identified for TA-54, MDA G (Figure 5.4-4):

- surface water runoff pathway;
- water dispersion by migration and evapotranspiration pathway;
- vadose zone transport pathway; and
- airborne transport pathway.

Surface Water Runoff Pathway

Annual precipitation at MDA G is highly variable, ranging from 6 to 30 in, but averaging about 14 in. Snowfall is greatest from December through March, with heavy snowfall being infrequent in other months. Snowfall averages about 51 in annually. About 40 percent of the precipitation occurs during intense thunderstorms in July and August. Thunderstorms often cause significant surface water runoff and soil erosion. The environmental transport of contaminants by the runoff pathway has three major components:

- deposition of contaminated sediments in drainage channels;
- contamination of surface water from dissolved and suspended solids; and

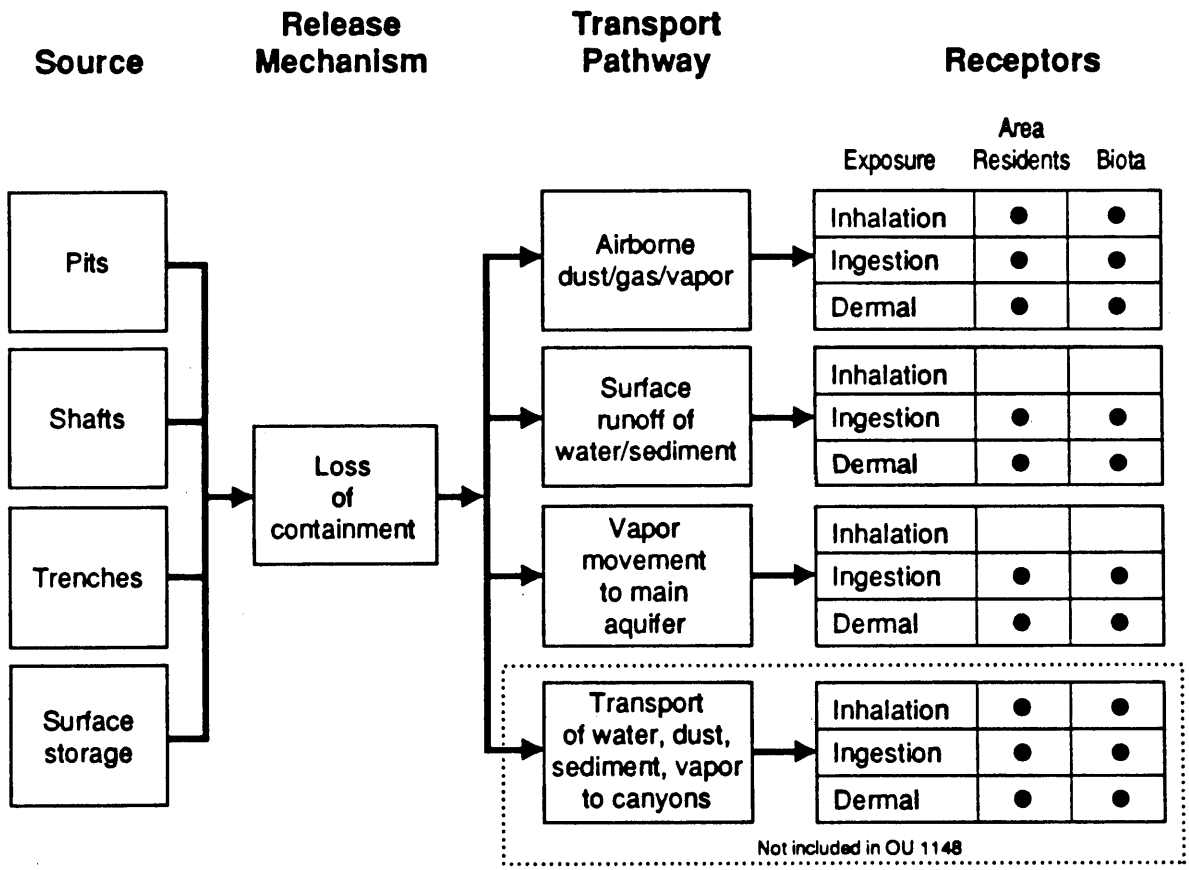


Figure 5.4-4 Conceptual model for MDA G.

- contamination of the shallow saturated zones in the alluvium of the canyon bottoms (alluvial aquifers).

The runoff could carry dissolved constituents or contaminated sediments from the mesa to the canyons. Volatile organic compounds transported to the canyons could be released upon evaporation, and solid residues could be resuspended and transported as dust through the air pathway.

Water Dispersion by Migration and Evapotranspiration Pathway

In 1959 and 1960, the United States Geological Survey (USGS) performed infiltration studies at MDA G to "investigate movement of water and nuclides during continuous infiltration (IT Corporation 1987, 0327). The rate of infiltration of water for the 1959 study decreased over time from about 0.75 gph/ft^2 to about 0.2 gph/ft^2. In the 1960 USGS study, the rate of infiltration decreased from about 0.68 gph/ft^2 to about 0.1 gph/ft^2 (IT Corporation 1987, 0327). The 1960 infiltration studies showed that seasonal changes in the log curve of the infiltration rate occurred during the months of April and September. A rapidly decreasing rate of infiltration occurred during the months in which the average temperature is less than about 50° F. It was further found that plants had no observable effect on the rate of infiltration (Rogers 1977, 0216).

Vadose Zone Transport Pathway

At MDA G, migration of contaminants in the subsurface could occur in unsaturated rock of the Bandelier Tuff. The mechanisms of importance in the vadose zone are:

- movement of tritiated water vapor and vapors of volatile organic compounds through the vadose zone; and

- infiltration of precipitation, which can provide the water to serve as a contaminant-carrying media.

Vapor transport is known to have occurred in the vadose zone in the vicinity of MDA G based on the presence of VOCs in two existing vapor-monitoring wells (see Section 5.4.1.2.1).

Airborne Transport Pathway

Air transport pathways at MDA G include wind entrainment of contaminated soil (resuspension) and releases of volatile organic compounds from within the soil. Wind speed, direction, and stability class and vegetative cover influence the dispersion of gases and vapors and resuspended dust. Similarly, soil physical properties, soil moisture content, and soil heat flux are important variables affecting resuspension and soil gas releases (Travis 1975, 0420; Abeele and Nyhan 1987, 0008).

5.4.1.2.3 Potential Public Health and Environmental Impacts

MDA G will be operated as an active waste management site under institutional control. Eventually, institutional control will be transferred to Bandelier National Monument. Corrective action will follow the conditional remedy guidance discussed in Section 1.3.1.

5.4.1.2.3.1 Potential Receptors

The potential receptors for contaminants released from MDA G are area residents and biota.

The town of Los Alamos lies approximately 3.8 mi to the northwest of MDA G, and has a population of 18,115. The town of White Rock lies within Los Alamos County, approximately 1.1 mi to the southeast of MDA G, and has a population of 6,768.

Land use in the immediate vicinity of MDA G is unlikely to change while present social and political institutions continue to function. Land currently occupied by TA-54 and the neighboring canyons is expected to remain under DOE/Laboratory control. Outside of the immediate vicinity of TA-54, land-use patterns can be expected to remain within the constraints imposed by the environment. Large-scale agriculture is not anticipated, although residential gardening is common. Low-intensity cattle grazing will occur in the lower reaches of the canyons to the east. Residences will remain primarily in developed areas.

Biota are also identified as potential receptors. Terrestrial biota are predominant because of the climate and the ephemeral nature of flow in the drainages. Deep-rooted flora are the only potential receptors for contaminants in subsurface soil and rock. Small mammals, birds, reptiles, and insects are common terrestrial fauna in the vicinity of MDA G (Foxx and Tierney 1982, 0101).

5.4.1.2.3.2 Routes of Exposure

Under the current land-use patterns in the vicinity of TA-54, the only two pathways or receptors of concern are airborne dispersion and surface water runoff (Figure 5.4-4). However, if land-use patterns change in the future (i.e., if MDA G ceases to be under the control of the Laboratory or the DOE), other exposure pathways, such as vadose zone transport and water dispersion by migration and evapotransportation, would be of concern. For airborne contaminants, inhalation, ingestion, and dermal contact have been identified as potential routes of exposure. Tritium and some organic chemicals can be absorbed through the skin. For contaminated soil surfaces, ingestion has been cited as the potential route of exposure to account for accidental ingestion of soil by adults and the often intentional ingestion by children. Ingestion of water is listed as a potential exposure route for running surface water as well as seeps and springs, although the potential for such ingestion is considered small.

5.4.1.2.3.3 Risk Assessment Issues

The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 version of the Installation Work Plan (IWP). This approach will be developed in adequate time for data analysis.

5.4.2 Evaluation Criteria

Selected SWMUs are recommended for no further action (NFA) according to criteria provided in Section 1.4, and are summarized in Chapter 6. The remaining SWMUs are all located in proximity within the boundary of institutional control, and are expected to have common release mechanisms and dispersal pathways. Thus, the remaining SWMUs will be addressed as a SWMU Aggregate by the Phase I SAPs.

5.4.2.1 Grouping of MDA G SWMUs According to Waste Regulations

Potential release sites at MDA G are described in the SWMU Report (LANL 1990, 0145). The groupings in the SWMU Report reflect the wastes contained at the sites and the dates of operation relative to implementation of RCRA regulations on November 19, 1980. A disposal site that received waste after July 26, 1982, qualified as a "RCRA-regulated unit," and a post-closure plan was submitted with the permit that included a ground-water monitoring plan to be conducted according to 40 CFR Parts 264.91-100 (Section 1.0 of this Work Plan). The Laboratory discontinued disposal of mixed waste and certain nonreactive chemical waste at MDA G on May 1, 1985 (LANL 1985, 0484). Regulations for management of radioactive waste were established by DOE Order 5820.2A (DOE 1988, 0074) on September 26, 1988. The New Mexico Hazardous Waste Act was enacted on July 25, 1990, and compliance was required after January 25, 1991. In the discussion below, sites are grouped according to these regulatory dates. The groups of disposal sites and their dates of operation or status are shown on Figure 5.4-5 and Tables 5.4-5 to 5.4-10, respectively (LANL 1990, 0145, IT Corporation 1991, 08-0020).

SWMU Group 54-a: Disposal Pits and Shafts Capped Before November 19, 1980 (SWMUs 54-017 and 54-019)

These sites contain waste disposed of prior to the implementation of RCRA on November 19, 1980 (Table 5.4-5). Waste pits contain routine laboratory wastes, such as radionuclides, chemicals, PCBs and asbestos, and nonretrievable uranium and transuranium radionuclides. Other wastes were generated as art of D&D activities and include contaminated soil and building debris, which was occasionally burned in the pits. Still other waste represents hardware such as sludge drums, filter plenums, and dryboxes.

Waste deposited in shafts consists of radioactive, TRU, and chemical waste including hot-cell waste, tritium, ^{235}U and ^{238}U, ^{137}Cs, ^{140}Ba, other radionuclides, beryllium, solvents, animal tissue, fuel elements, control rods, and PCB oil. Waste volumes of some shafts are unavailable. Some shafts are lined with corrugated metal pipe; other shafts are unlined.

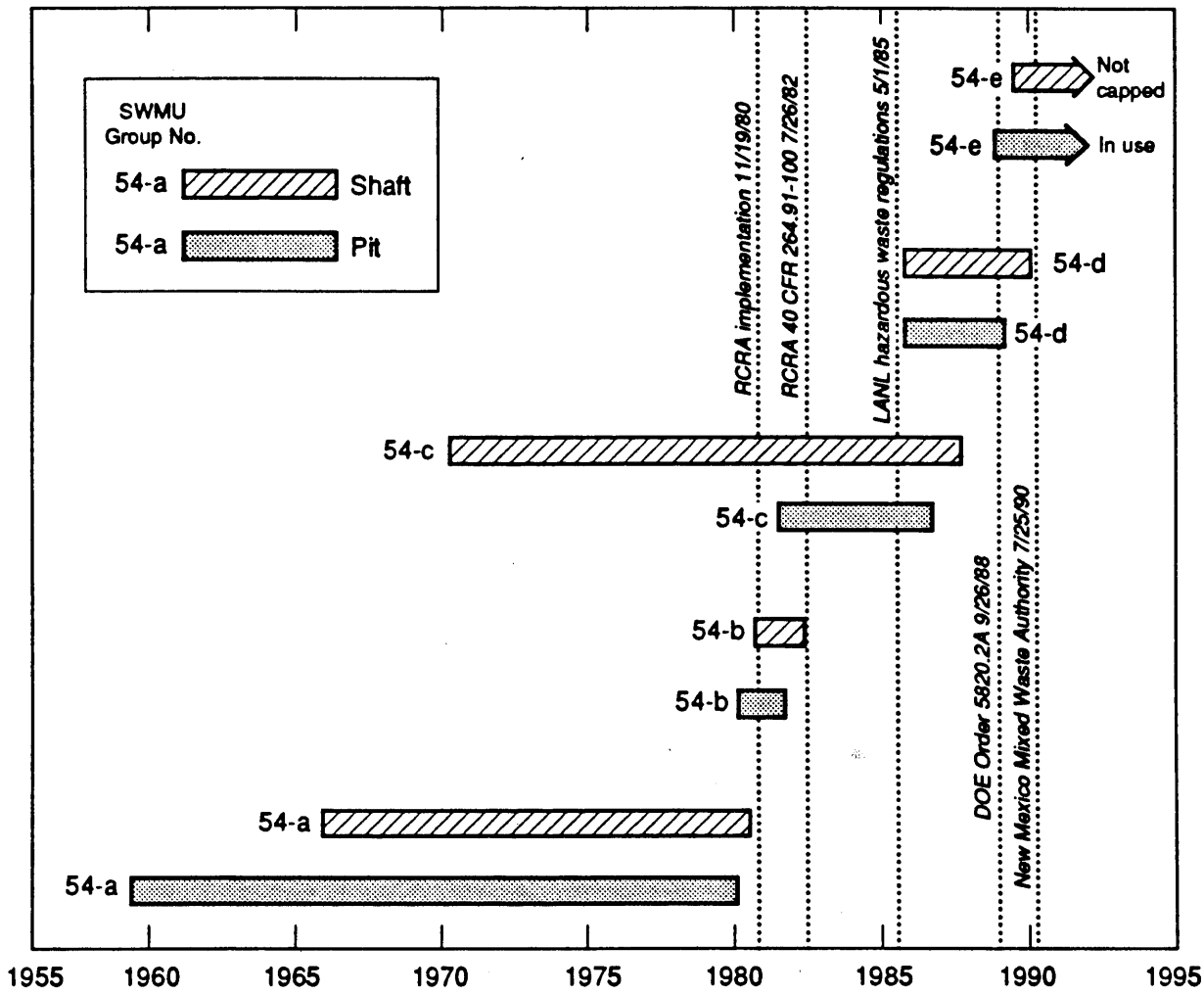


Figure 5.4-5 SWMU groups considered in TA-54, MDA G. Wide horizontal bars indicate duration of disposal operation.

SWMU Group 54-b: Disposal Pits and Shafts Closed Before July 26, 1982 (SWMUs 54-018 and 54-020)

These disposal sites were closed after the implementation of RCRA, but are not designated as "RCRA-regulated units" under 40 CFR Part 264.91-100 because they were closed before July 26, 1982 (Table 5.4-6). Waste contents of the pits and shafts in SWMU Group 54-b are generally the same as those in SWMU Group 54-a.

SWMU Group 54-c: Disposal Pits and Shafts Operated after July 26, 1982, and Before May 1, 1985 (SWMU 54-018 and 54-020)

These disposal sites received waste after July 26, 1982, and before May 1, 1985 (Table 5.4-7). Therefore, they are "RCRA-regulated units" under 40 CFR Part 264.91-100. Waste contents of the pits and shafts in SWMU Group 54-c are generally the same as those in SWMU Groups 54-a and 54-b.

SWMU Group 54-d: Disposal Pits and Shafts Operated After May 1, 1985, and before September 26, 1988 (SWMUs 54-018 and 54-020)

These disposal sites received waste after May 1, 1985, and before issuance of DOE Order 5820.2A on September 26, 1988; therefore, they are not expected to contain mixed waste (Table 5.4-8). Radioactive waste contents of the pits and shafts in SWMU Group 54-d are otherwise expected to be similar to those of SWMU Groups 54-a to 54-c.

SWMU Group 54-e: Disposal Pits and Shafts Operated After September 26, 1988 (SWMUs 54-018 and 54-020)

These disposal sites received waste after issuance of DOE Order 5820.2A on September 26, 1988 (Table 5.4-9). Radioactive waste contents of the pits and shafts in SWMU Group 54-e are expected to be similar to those of SWMU Group 54-d, except that Pit 31 contains asbestos.

5.4.3 Data Needs and Data Quality Objectives

Existing information on disposal pits and shafts designated as SWMUs 54-017, 54-018, 54-019, and 54-020 is described in Section 5.4.1.2.1. The data needs for site characterization are discussed below.

5.4.3.1 Health and Safety Risks

5.4.3.1.1 Source Characterization

Quantitative documentation describing radioactive waste disposal is only available since 1971. Quantitative documentation of TSCA and RCRA waste constituents is not available. There have been releases of radioactive and RCRA constituents, but it is not possible to characterize potential public health or environmental hazards or to assess likely remedial options based on existing information.

Collection of the data presented in Table 5.4-13 are necessary to characterize the source term, the vertical and horizontal extent of the vapor plume, and the movement of tritium.

5.4.3.1.2 Environmental Setting

The primary release mechanisms from MDA G pits and shafts are shown in the conceptual model (Figure 5.4-4). Wastes that were disposed of in MDA G were often packaged in drums or other containers to provide containment during handling. Other waste was placed in lined shafts, and still other waste was placed without containment in unlined disposal pits. To the extent that packaging material or the walls of a pit or shaft fail to contain the constituents, they are released and become available for transport. Primary constituents releases might result from loss of containment of waste stored in pits or shafts. The most important transport pathways that might result in exposure of area residents are dispersal of constituents through air transport of dust or vapor, including contaminated water vapor from evapotranspiration of rain or snow. Because there is little potential for downward flow of water to the main aquifer, the only pathways considered for ground-water contamination is by vapor phase transport in subsurface tuff or through surface water erosion of soil or windblown dust from the mesa into the adjacent canyons and subsequent percolation into perched water in Pajarito Canyon.

Transport by Surface Sediment Erosion

Surface water run off could carry dissolved constituents or contaminated sediments from the mesa to the canyons. Volatile organic compounds and tritium thus located in the canyons could be released from the sediments by evapotranspiration, and metals and other radionuclides could be resuspended and transported from the canyons through the air pathway.

The data needed for the characterization of potential pathways are presented in Table 5.4-14. These data gaps will be addressed within the defined institutional control area, at its boundary, and slightly beyond its boundary. Sampling beyond the institutional control point will still occur within the OU. No data will be collected within the adjacent OUs (i.e., the canyons).

Airborne Transport of Gases and Vapors

VOCs, SVOCs, or tritiated water adsorbed onto soil could be released by evapotranspiration and be transported downwind to receptors off site. SVOCs, metals, or tritiated water could possibly adsorb onto soil particles and also be transported downwind. Potential exposures from this pathway could occur through inhalation and ingestion.

5.4.3.1.3 Potential Receptors

The data needed to identify and characterize the potential receptors is based on inputs into models for determining risk. The ER Program is currently developing

TABLE 5.4-13
INFORMATION NEEDED FOR PHASE I SOURCE CHARACTERIZATION OF MDA G SUBSURFACE DISPOSAL UNITS[a]

1.	Constituent Concentrations in Media
	Radionuclides of Concern
	Volatile Organic Compounds (VOCs)
	Semivolatile Organic Compounds (SVOCs)
	Metals
	PCBs
	Pesticides
	Reactive Cyanides
2.	Media
	Surface Water Runoff
	Soils/Sediments
	Air

[a]These constituents and associated analytical methods are given in the Laboratory's IWP (LANL 1991, 0553).

TABLE 5.4-14
INFORMATION NEEDED FOR PHASE I TRANSPORT PATHWAY CHARACTERIZATION OF MDA G SUBSURFACE DISPOSAL UNITS

1. Surface Water Runoff Pathway

   Monthly Rainfall Averages
   Drainage Patterns
   Background Concentration of Each Constituent

2. Soils/Sediments Pathway

   Respirable Dust Fraction
   Erodability
   Organic Carbon Content
   Moisture Content
   Background Concentration of Each Constituent

3. Air Pathway

   Wind Roses
   Wind Erosion Data
   Background Concentration of Each Constituent

4. Subsurface Migration Pathway

   Rock Mineralogy
   In Situ Air Permeability of Characteristic Rock Types
   Fracture Density
   Hydraulic Conductivity
   Background Concentration of Each Constituent

baseline risk assessment scenarios and criteria that will be presented in the 1992 version of the IWP. This approach will be developed in adequate time for data analysis. Table 5.4-15 lists the data needed for receptor characterization.

5.4.3.2 MDA G Data Quality Objectives

The decision processes and data quality objectives (DQOs) described in this section are specific to MDA G SWMUs, and follows the more general process described in Section 1.4. Refer to Section 1.4 for definitions of terms and decision criteria, and to Figure 1.4-1 for the decision flow chart.

5.4.3.2.1 MDA G Decision Process

Decision Point 1:

On the basis of existing information, is there any potential risk to human health or the environment from the subsurface disposal units at MDA G?

Yes. Radionuclides and hazardous constituents have been reported in laboratory records, and releases have been reported.

Decision Point 2:

Is existing information sufficient to allow development of a Phase II sampling plan?

No. Existing information only identifies radionuclides recorded in waste disposal forms used since 1971. None of the radionuclide inventories are based on measured activities at MDA G. Other potentially hazardous constituents are identified only as "chemicals," "metals," or "solvents." Most of the existing information reported in Section 5.4.1.2.1 is 15 years old. The four vapor monitoring wells are insufficient to map the vertical and horizontal extent of the VOC vapor plume.

A Phase I SAP will be implemented at MDA G, and as quantitative analytical data become available, Phase I SAPs will be revised as appropriate. Data acquired in the Phase I investigation will serve as input to the next decision (Figure 1.4-1).

Decision Point 3:

Do the data collected in Phase I sampling confirm the presence of COCs at MDA G?

The following Phase I sampling plans were designed to answer this question (see Section 5.4.4). The SAPs were developed according to the DQO process.

5.4.3.2.1 Phase I Data Quality Objectives for MDA G

The DQOs for Phase I SAPs follow the format of Section 1.4.3.1, and the diagram shown on Figure 1.4-2.

TABLE 5.4-15
INFORMATION NEEDED FOR PHASE I POTENTIAL RECEPTOR CHARACTERIZATION ACCORDING TO THE MDA G CONCEPTUAL MODEL

1. General Land Use

   Local uses and possible future uses of MDA G:

   a. Waste disposal
   b. Closure with continued institutional control

2. Human

   Human use of or access to MDA G and adjacent lands, including:

   a. Relationship between population centers and prevailing wind direction.
   b. Native American access to archeological sites under institutional controls.
   c. Recreational use of adjacent lands under management by Bandelier National Monument.

3. Demography

   A demographic profile of the people who use or have access to MDA G and adjacent land, including, but not limited to: age; sex; and sensitive subgroups. These receptor groups will be investigated if Phase II sampling is undertaken.

4. Biota

   A description of the biota on, adjacent to, or affected by MDA G. These receptors will be investigated if Phase II sampling is undertaken.

5. Ecology

   A description of the ecology within and adjacent to MDA G will be provided if Phase II sampling is undertaken.

6. Endangered/Threatened Species

   A description of any endangered or threatened species near MDA G will be provided if Phase II sampling is undertaken.

7. Risk Assessment

   The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 version of the Installation Work Plan. This approach will be developed in adequate time for data analysis.

Problem Statement

Constituents of concern (COCs) are known to be present in subsurface disposal units, but data on concentration and specific locations are not sufficient to allow design of an effective Phase II SAP.

Questions to be Answered

Are the concentrations of COCs concern in air, water, soils, sediments, or the subsurface above background levels, or above a health risk-based action level?

Decision Inputs/Data Needs for MDA G

COCs for MDA G are summarized in Table 5.4-13. VOCs, SVOCs, and metals are specified in the Laboratory's IWP (LANL 1991, 0553) and action levels for many of the constituents are available in Proposed RCRA Subpart S.

No suite of Radionuclides of Concern (ROCs) is specified in Proposed RCRA Subpart S. Although the Generic QAPjP (LANL 1991, 0412) includes a generic suite of radionuclides, OU 1148 has a unique history of radioactive waste disposal, and requires a specific description of ROCs. Existing information on the MDA G waste inventory was reviewed, and a selected list of ROCs was developed (Table 5.4-3). This proposed suite of radionuclides will be used in future environmental geochemistry and transport calculations. Preliminary modeling results (Section 5.4.1.2.1.6) indicate that this suite of ROCs might be further limited to a much smaller number of the most mobile radionuclides.

Because the geochemical and transport models have not been extended to the entire MDA G radionuclide inventory at this date, an alternate suite of ROCs was developed from the ROCs addressed in earlier remedial action investigations at LANL (LANL 1981, 0141), with certain radionuclides added, as described in Section 5.4.3.1.1. The radionuclides of concern developed for the Phase I SAPs are given in Table 5.4-16.

Phase I SAPs were developed to determine the COC concentration in each environmental transport medium in the conceptual model (Figure 5.4-4). The COCs in each transport medium of the Phase I SAPs are summarized in Table 5.4-17.

Decision Domain

- The spatial domain includes all of TA-54, MDA G, and excludes the adjacent canyons, which are addressed in OU 1049.
- Area residents may potentially receive exposures.

Temporal Limits

The Laboratory will maintain institutional control of MDA G, as discussed in Section 1.0.

TABLE 5.4-16
RADIONUCLIDES OF CONCERN AT MDA G

^{3}H, ^{60}Co, ^{90}Sr, ^{90}Y, ^{99}Tc, ^{241}Am, ^{137}Cs, ^{210}Pb, ^{238}Pu, $^{239,240}Pu$, ^{241}Pu, ^{226}Ra, ^{228}Th, ^{230}Th, ^{232}Th, total U, ^{234}U, ^{235}U, ^{238}U.

TABLE 5.4-17
CONSTITUENTS OF CONCERN ADDRESSED
IN ENVIRONMENTAL TRANSPORT MEDIA AT MDA G

Transport Medium	Constituents of Concern[a]	Phase I SAP (Section Number)
Surface Water	VOCs[b], SVOCs[c], metals, pesticides, PCBs[d], cyanide, ROCs[e]	5.4.4.1
Surface Sediments	VOCs[b], SVOCs[c], metals, pesticides, PCBs[d], cyanide, ROCs[e]	5.4.4.2
Underground Soils (Cores)	VOCs[b], SVOCs[c], metals, pesticides, PCBs[d], cyanide, ROCs[e]	5.4.4.3
Underground Vapor	VOCs	5.4.4.4
Air (Passive)	VOCs	5.4.4.5
Air (High Volume)	SVOCs, TSPs[f], metals pesticides, PCBs, ROCs	5.4.4.6
Air (High Volume)	^{3}H	5.4.4.7

a Specific constituents are listed in the indicated Phase I SAP
b Volatile Organic Compounds
c Semivolatile Organic Compounds
d Polychlorinated biphenyls
e Radionuclides of Concern (see Table 5.4-16)
f Total Suspended Particulates

Decision Rule/Logic Statement

The decision made at Decision Point 3 will be based on the following rule: If the maximum concentration of any COC in any sample does not exceed action levels or the natural background concentration, MDA G will be recommended for NFA. This outcome of the Phase I plan is unlikely at MDA G. Because historic releases have occurred and some COCs have been reported (Section 5.4.1.2.1), the Phase I plans described below have been designed to not only confirm the presence of suspected COCs, but to provide initial input data for transport models, and to further health risk assessments. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 version of the IWP. This approach will be developed in adequate time for data analysis. The results of the Phase I SAPs for MDA G investigations will be used to validate transport models, to provide initial health risk estimates, and to develop more comprehensive Phase II SAPs.

Acceptable Uncertainty Limits

Because MDA G site and waste characterization data are lacking, it is not possible to determine true risk ranges and tolerance limits. The characterization data needed to develop Phase II SAPs and perform health risk assessments will be determined using the results of Phase I sampling and the risk assessment approach to be outlined in the 1992 IWP.

Phase I Sampling and Analysis Plans

Because of the wide diversity of COCs at MDA G, field and analytical data quality requirements, Phase I analytical levels of concern, analytical methods, PARCC parameters, and sample collection quality requirements are specified for each COC in the following Phase I SAPs, and the Support Documents for Sampling and Analysis Plans (Appendix B).

5.4.4 Sampling Plans

5.4.4.1 MDA G Surface Water Runoff Sampling

5.4.4.1.1 Sampling and Analysis Components

The purpose of collecting and analyzing surface water runoff samples from MDA G is to accumulate technically accurate and legally defensible data. The data will be used to determine the potential for off-site migration of radionuclides or hazardous waste constituents in the waterborne pathway. The data will be validated according to the U.S. Environmental Protection Agency (EPA) functional guidelines for organic analysis (EPA 1988, 0293) and inorganic analysis (EPA 1988, 0296). Validation is necessary so that the data will be of such quality that they can be used in risk assessment calculations. Currently, there are no published EPA methods for validating all radionuclide analyses.

5.4.4.1.2 Sampling and Analysis Approach

This SAP is designed to obtain information on contaminant concentrations and contaminant transport in the environment around MDA G that will support DQO decisions. One of the primary sediment transport mechanisms from Area G is surface water runoff; therefore, surface water samples will be collected from the nine primary runoff pathways around MDA G during a heavy rain storm.

5.4.4.1.3 Primary Data Quality Factors

5.4.4.1.3.1 Prioritized Data Uses

Data to be collected during the Phase I field investigation at MDA G are necessary for site characterization and risk assessment.

- Site Characterization - The existing data for MDA G do not include all of the regulated VOCs and SVOCs, metals, pesticides, PCBs, cyanide, or ROCs, and have not been validated. Additional data will be collected to support the use of the existing data and to satisfy data needs.

- Risk Assessment - The chemical source term for MDA G is not fully understood. The source term was characterized primarily by literature review only. Laboratory records indicate that chemicals were included among wastes at MDA G; however, the identities of the VOCs and the extent of transport in surface water runoff are unknown at this time. Additional data will be collected to determine the nature and extent of the contaminant transport via this pathway. The data collected during Phase I will also be used as input to risk assessment calculations.

5.4.4.1.3.2 Appropriate Analytical Levels

Samples collected will be screened in the field and analyzed in a laboratory using EPA SW-846 (third edition) protocol. Photoionization Detectors (PIDs) and Flame Ionization Detectors (FIDs) will be used in the field to screen for organic vapors; and alpha, beta, and gamma survey instruments will be used for field screening ionizing radiation. The analytical levels are:

Level I Field Screen: PID/FID screening instruments; alpha, beta, gamma survey instruments,

Level II Field Analysis: Gas Chromatography (GC) with either a PID, FID, or Electron Capture Detector (ECD),

Level III SW-846 Laboratory Methods, and

Level V Radionuclide Analysis Laboratory Methods.

5.4.4.1.3.3 Primary Contaminants of Concern

The contaminants of concern at MDA G are VOCs, SVOCs, metals, pesticides, PCBs, cyanide, and ROCs. ROCs for OU 1148 are listed in Table 5.4-18.

5.4.4.1.3.4 Levels of Concern

Appendix F of the IWP (LANL 1991, 0553) and 40 CFR 264, Proposed Subpart S, contain information on constituent levels of concern. Health risk-based determinations of levels of concern will be developed for constituents not listed in Appendix F. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 IWP. This approach will be developed in adequate time for data analysis.

5.4.4.1.3.5 Required Quantitation Limits

Quantitation limits for laboratory analysis of hazardous and radioactive constituents in water are given in Tables V.3 through V.9 of the Laboratory's Generic Quality Assurance Project Plan (QAPjP) (LANL 1991, 0412). Analytical methods used for surface water runoff samples at MDA G will fall in the range of these quantitation limits. The quantitation limits will follow the current SW-846 protocol for VOCs, SVOCs, pesticides, PCBs, cyanide, and metals. Level V analysis for radionuclides, including tritium, will use the current Laboratory-approved analytical contractor or EM-9.

5.4.4.1.3.6 Critical Samples

The water samples collected during a heavy storm are critical samples because they represent potential transport beyond institutional control.

5.4.4.1.4 Rationale for Sampling Activity

Surface water runoff sampling stations (Figure 5.4-6) were chosen to provide data that can be compared with data collected by EM-8's Environmental Surveillance Program. The Environmental Surveillance Program includes nine sediment sampling locations near MDA G and near the Pajarito Canyon stream channel (Locations 1-6), in runoff channels flowing into Cañada del Buey (Locations 7 and 8), and in the Cañada del Buey channel (Location 9). Nine surface water sampling stations were located near or within the MDA G fence in order to sample runoff that will contribute to the sediment sampling sites. Stations R1-R5 sample upstream of sediment sampling locations 1-5 (Figure 3.4-1). Runoff locations R6 and R7 are at the weir station and at the asphalt drainage ditch that are designed to collect and channel runoff water. R8 is located upstream of sediment location 6. Because Mesita del Buey slopes toward Pajarito Canyon, there is little runoff to Cañada del Buey; however, R9 is located at the steepest channel on the north side of the canyon rim.

TABLE 5.4-18
RADIONUCLIDES OF CONCERN FOR OU 1148,
ANALYTICAL METHODS, AND METHOD DETECTION LIMITS[a]

Radionuclide	Method	Method Detection Limit - Water[b]	Method Detection Limit - Soil/Sediment[c]
Americium-241	Radiochemical separation and alpha spectrometer	3.0 pCi/g	0.002
Americium-241	Gamma spectrometry	0.04	0.002
Cesium-137	Gamma spectrometry	20.0	0.1
Gamma spectroscopy (All peaks reported)	Gamma spectrometry	15-300	0.1-2.0
Gross alpha	Gas flow proportional counter	3.0-5.0	4.0-10.0
Gross beta	Gas flow proportional counter	3.0-6.0	5.0-12.0
Isotopic plutonium (Pu-238, -239, -240, -241)	Radiochemical separation and alpha spectrometer	0.04	0.005
Isotopic thorium (Th-228, -230, -232)	Radiochemical separation and alpha spectrometer	0.1	0.01
Total uranium	Inductively Coupled Plasma Mass Spectroscopy (ICP MS)	2.0 g/g	0.5 g/g
Isotopic uranium (U-234, -238)	Radiochemical separation and alpha spectrometer	0.2	0.01
Uranium-235	Radiochemical separation and alpha spectrometer	0.2	0.05 pCi/L
Radium-226	Radiochemical separation and alpha scintillation counter	0.5	0.5
Strontium-90	Gas flow proportional counter	3.0	2.0
Yttrium-90	Gas flow proportional counter	3.0	2.0
Tritium	Distillation and liquid scintillation	400	400 pCi/L
Lead-210	TBD[d]	TBD	TBD
Technetium-99	TBD	TBD	TBD
Cobalt-60	TBD	TBD	TBD

[a]"Generic Quality Assurance Project Plan (QAPjP)," Rev. 0 May 20, 1991, Tables V.8 and IX.1, Los Alamos National Laboratory. "Formerly Utilized MED/AEC Sites Remedial Action Program (FUSARP)" DOE/EV-005/30, LA-8890-ENV, UC-70, Final Report, May 1981, Los Alamos National Laboratory.
[b]Units are picocuries per liter (pCi/L) except where otherwise noted.
[c]Units are picocuries per gram (pCi/g) except where otherwise noted.
[d] TBD - to be determined.

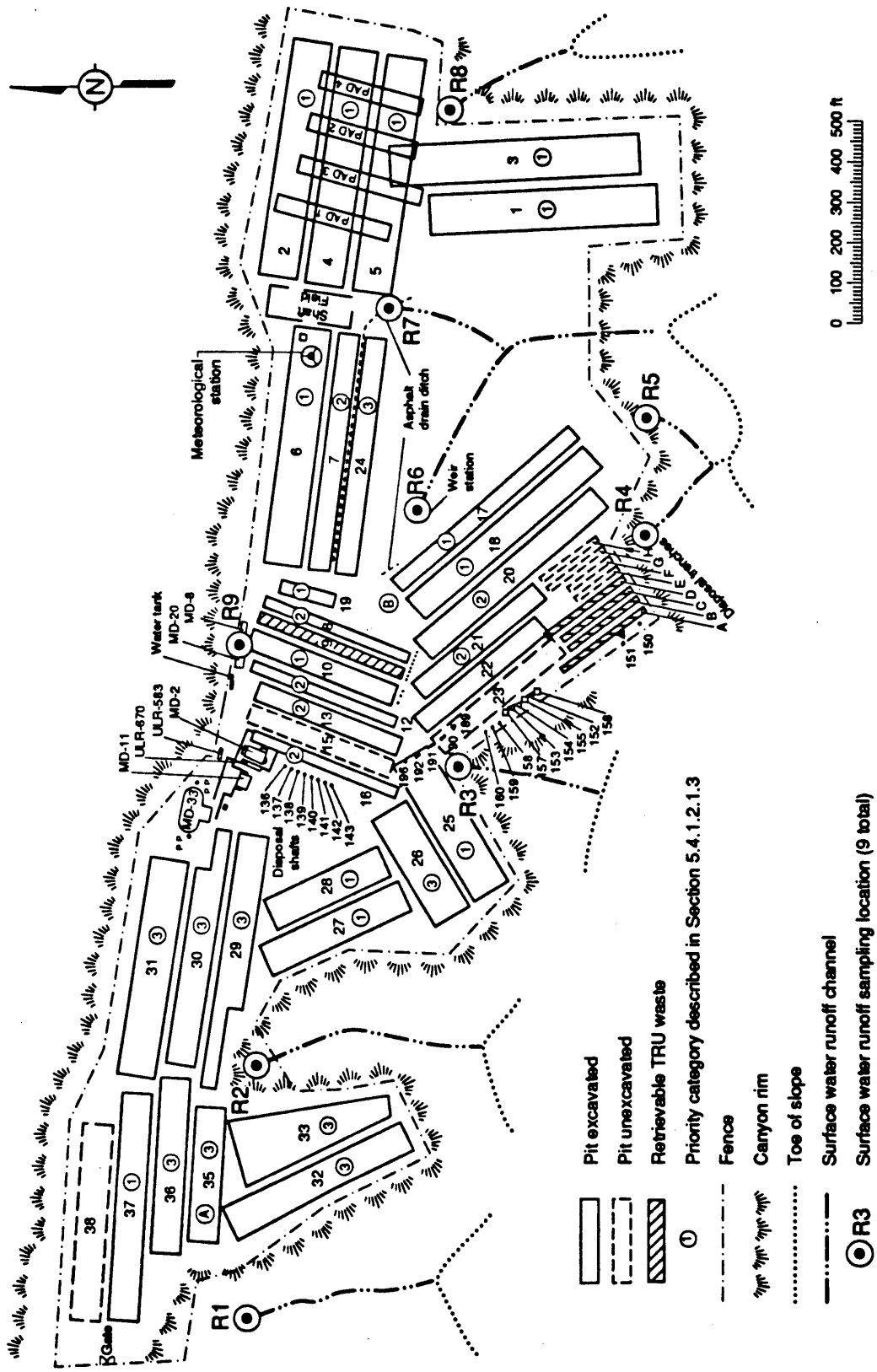


Figure 5.4-6 Surface water runoff sampling locations at MDA G.

The rationale for surface water runoff sampling from the nine drainage areas is to:

- determine if VOCs, SVOCs, metals, pesticides, PCBs, cyanide, and ROCs are being discharged from MDA G;
- further define source terms;
- collect data that can be used to support and supplement existing data for the DQO process; and
- collect data that can be used in a risk assessment.

5.4.4.1.5 Sampling Activity

One set of nine surface water runoff samples will be collected from the primary runoff pathways at MDA G during Phase I sampling. The analytical results will be compared to the Laboratory's Environmental Surveillance Program results (Environmental Protection Group 1990, 0497). The sampling locations are shown on Figure 5.4-6. Table 5.4-19 summarizes the number of samples, the number of QC samples, and the analytical requirements for the Phase I sampling. It also describes the types of required QC samples. Surface water runoff sampling procedures are presented in Section 1.0 of Appendix B.

5.4.4.1.6 Remaining SAP Elements

The remaining required elements of this SAP are common to all of the SAPs prepared for OU 1148. These common elements are listed in Table 5.4-20 and are located in Appendix B of this RFI Work Plan.

5.4.4.1.7 Phase II SAP

If the results of Phase I surface water runoff sampling indicate that COCs exceed health risk-based criteria, then Phase II sampling will be conducted at MDA G. Surface soil samples will be collected in nine nodes of an MRI grid and analyzed for the COCs that exceeded the health risk-based criteria in the surface water runoff samples. This Phase II sampling plan is designed to determine the extent of contamination and to provide data to be used in health risk assessments. Table 5.4-21 summarizes the number of samples and analytical requirements for the Phase II sampling activities. The Phase II plan outlined in this table may be modified, as appropriate, after results of Phase I sampling are reviewed.

5.4.4.1.8 Health and Safety

This SAP will follow the procedures outlined in the Laboratory's Environment, Safety and Health Manual (LANL 1990, 0335) and Annex III of this RFI Work Plan.

TABLE 5.4-19
PHASE I SAMPLING AND ANALYSIS PLAN TABLE FOR SURFACE WATER RUNOFF SAMPLING AT MDA G

Media	# of Samples	# of QC[a] Samples	Total Samples	Analysis
Water	9	4	13	VOCs SVOCs Metals Pesticides PCBs Cyanide ROCs[b]

[a]Includes Trip Blank, Field Blank, Duplicate Sample, and Equipment (Rinsate) Blank.

Trip Blank: Two 40 ml VOC sample containers filled with organic-free water at the Sample Coordination Facility. Filled trip blanks accompany sample bottles to the field, remain unopened throughout the sampling activity, and return with shipment to the analytical laboratory. Collected only when sampling for VOCs.

Field Blank: Organic-free water is poured into sample containers at the sampling site.

Duplicate Samples: Collect two separate surface water runoff samples simultaneously.

Equipment (Rinsate) Blank: Obtained by running organic-free water over cleaned, decontaminated sampling equipment. Rinse the equipment surface that comes into contact with a sample.

[b] Radionuclides of Concern (ROCs) for OU 1148 (see Table 5.4-18).

TABLE 5.4-20
FIELD SAMPLING PLAN ELEMENTS LOCATED IN APPENDIX B

1. Sample Collection Procedures
2. Field Documentation
3. Sample Preservation and Handling Procedures
4. Field Quality Assurance
5. Variance Situation
6. Equipment List
7. Equipment Calibration
8. Decontamination Procedures
9. Precision, Accuracy, Representativeness, Completeness, and Comparability Review

TABLE 5.4-21
PHASE II SURFACE WATER RUNOFF SAMPLING
AT MDA G

Media	Phase II Sampling	Rationale	Analysis	# of Samples
Soil	9 locations	Sample at nine locations in the surface water runoff channel to determine the extent of contamination.	COCs	9 + 4 QCs 13 Total

5.4.4.1.9 Schedule

See Annex I.

5.4.4.2 MDA G Surface Sediment Sampling

5.4.4.2.1 Sampling and Analysis Components

The purpose of collecting and analyzing surface sediment samples from MDA G is to accumulate technically accurate and legally defensible data. The data will be used to determine the potential for off-site migration of radionuclides or hazardous waste constituents in sediment pathways. The data will be validated according to EPA functional guidelines for organic analysis (EPA 1988, 0293) and inorganic analysis (EPA 1988, 0296). Validation is necessary so that the data will be of such quality that they can be used in risk assessment calculations. Currently, there are no published EPA methods for validating all radionuclide analyses.

5.4.4.2.2 Sampling and Analysis Approach

This SAP is designed to obtain information on contaminant concentrations and contaminant transport in the environment around MDA G that will support DQO decisions. One of the primary sediment transport mechanisms from TA-54 is surface water runoff during heavy rain storms; therefore, sediment sampling will take place in the nine primary runoff areas at MDA G.

5.4.4.2.3 Primary Data Quality Factors

5.4.4.2.3.1 Prioritized Data Uses

Data to be collected during the Phase I field investigation at MDA G is necessary for site characterization and risk assessment.

- Site Characterization - The existing data for MDA G do not include all of the regulated VOCs and SVOCs, metals, pesticides, PCBs, cyanide, and ROCs, and have not been validated. Additional data will be collected to support the use of existing data, and to satisfy the data needs.

- Risk Assessment - The chemical source term for MDA G is not fully understood. The source term was characterized primarily for radionuclides only. Laboratory records indicate that chemicals and other constituents were disposed of at MDA G, along with radionuclides. The identities of RCRA constituents and other COCs in the surface water runoff channel

sediments are unknown at this time. Additional data must be collected to determine the nature and extent of contamination in surface water runoff channel sediments. These data will be used in risk assessment calculations.

5.4.4.2.3.2 Appropriate Analytical Levels

Samples collected will be screened in the field and analyzed in a laboratory using EPA SW-846 (third edition) protocol. PIDs and FIDs will be used in the field to screen for organic vapors; and alpha, beta, and gamma survey instruments will be used for field surveying ionizing radiation. The analytical levels include:

Level I Field Screen: PID/FID screening instruments; alpha, beta, gamma survey instruments,

Level II Field Analysis: GC with either a PID, FID, or ECD,

Level III SW-846 Laboratory Methods, and

Level V Radionuclide Analysis Laboratory Methods.

5.4.4.2.3.3 Primary Contaminants of Concern

The contaminants of concern at MDA G are VOCs, SVOCs, metals, pesticides, PCBs, cyanide, and ROCs. A list of radionuclides of concern at OU 1148 is given in Table 5.4-18.

5.4.4.2.3.4 Levels of Concern

Appendix F of the IWP (LANL 1991, 0553) and 40 CFR 264, Proposed Subpart S, contain information on constituent levels of concern. Health risk-based determinations of levels of concern will be developed for constituents not listed in Appendix F. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 IWP. This approach will be developed in adequate time for data analysis.

5.4.4.2.3.5 Required Quantitation Limits

Quantitation limits for laboratory analysis of hazardous and radioactive constituents in soil are given in Tables V.3 through V.9 of the Laboratory's Generic QAPjP (LANL 1991, 0412). Analytical methods used for sediment samples at MDA G will fall in the range of these limits. The quantitation limits will follow the current SW-846 for VOCs, SVOCs, metals, pesticides, PCBs, and cyanide. Level V analysis for radionuclides will use the current Laboratory-approved analytical contractor or EM-9.

5.4.4.2.3.6 Critical Samples

Sediment samples collected in the primary drainage channels leading from MDA G are critical because they represent potential transport beyond institutional control.

5.4.4.2.4 Rationale for Sampling Activity

Surface water runoff channels from Mesita del Buey into Pajarito Canyon were divided into nine sections. Figure 5.4-7 shows the locations of the nine drainage pathways to be sampled. The drainage ways have been divided into a 3- by 20-ft grid of squares, and nine sample locations were randomly selected. Figure 5.4-8 shows the nine grids and the nine randomly selected sample points within the grids (9 grids x 9 points per grid = 81 samples). The grids were constructed long and narrow to reflect the geomorphic drainage features. The number of samples to be collected from each drainage channel was chosen to be nine to provide an adequate description of the variability of contamination in the channel.

The rationale for surface sediment sampling from the nine drainage areas is to:

- determine if VOCs, SVOCs, metals, pesticides, PCBs, cyanide, and ROCs are being discharged from MDA G;
- further define source terms;
- collect data that can be used to support and supplement existing data for the DQO process; and
- collect data that can be used in a risk assessment.

5.4.4.2.5 Sampling Activity

One set of nine surface sediment samples will be collected from each of the nine drainage pathways during Phase I sampling. The results will be compared to the Laboratory's Environmental Surveillance Program results from surface sediment sampling in the adjacent canyons (Environmental Protection Group 1990, 0497). Table 5.4-22 summarizes the number of grab samples, the number of QC samples, and the analytical requirements for the Phase I sampling. Surface sediment sampling procedures are presented in Section 2.0 of Appendix B.

5.4.4.2.6 Remaining SAP Elements

The remaining required elements of this SAP are common to all of the SAPs prepared for OU 1148. These common elements are listed in Table 5.4-20 and are located in Appendix B of this RFI Work Plan.

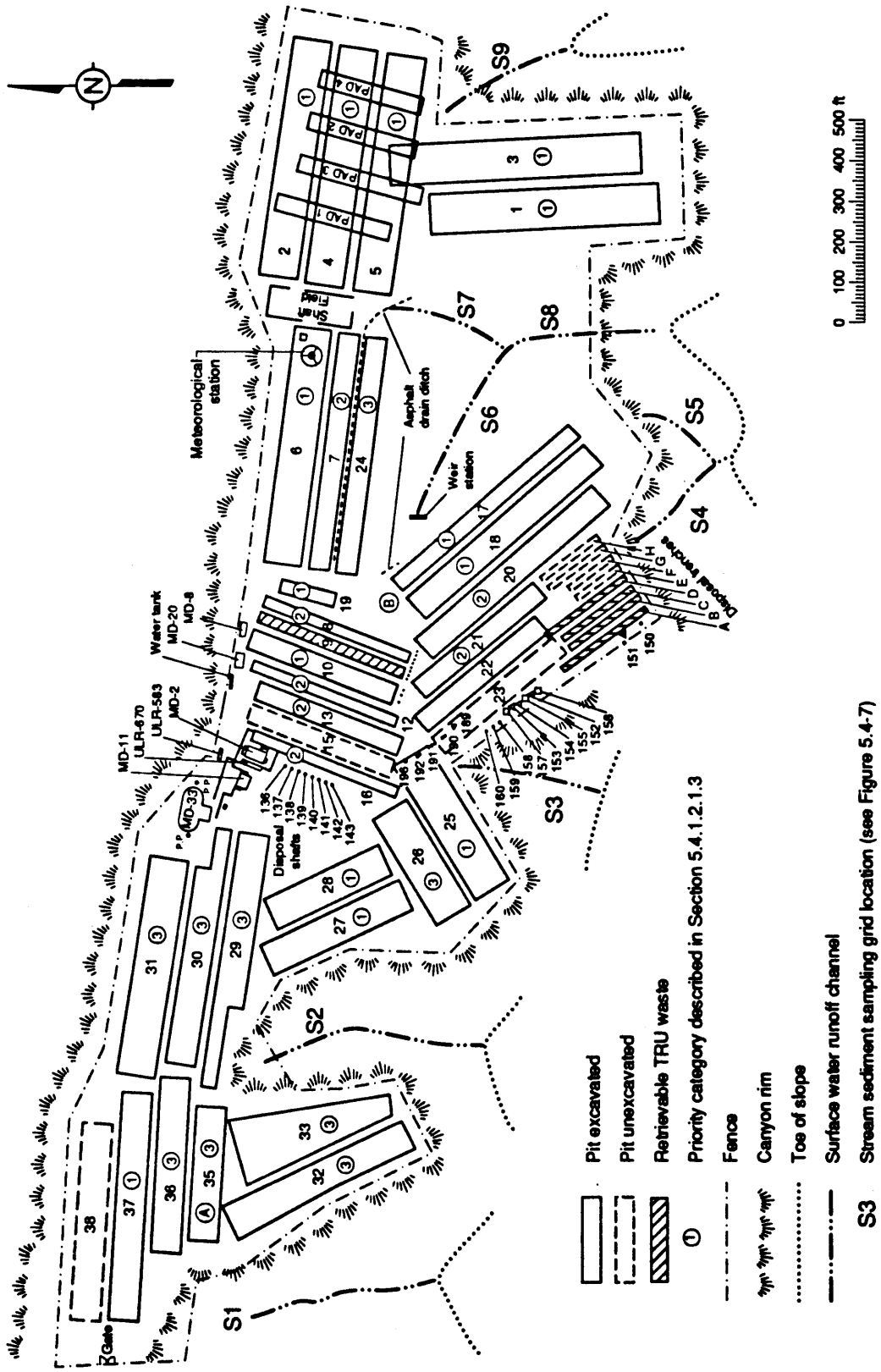


Figure 5.4-7 Surface sediment sampling locations at MDA G.

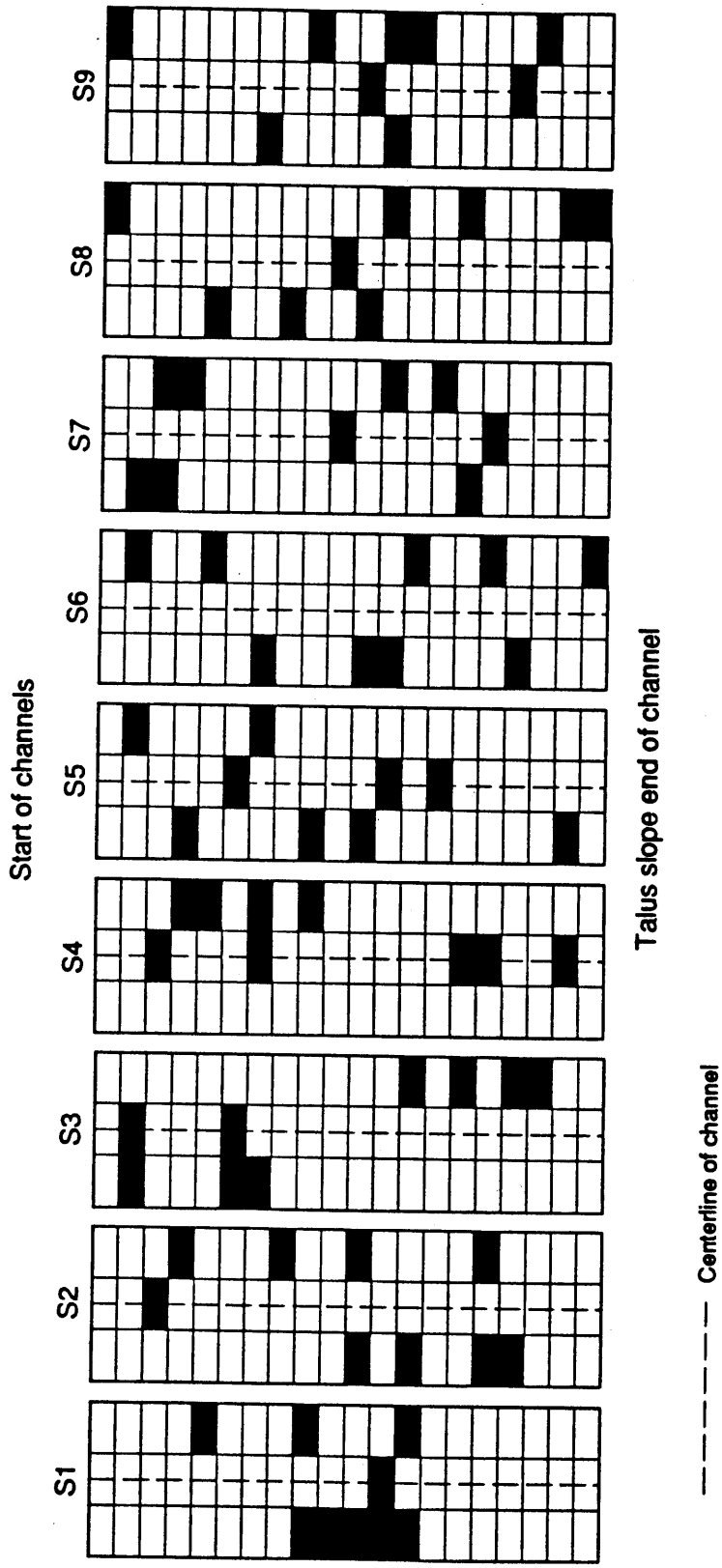


Figure 5.4-8 Sampling grids for surface sediments at MDA G.

TABLE 5.4-22
PHASE I SAMPLING AND ANALYSIS PLAN TABLE
FOR SURFACE SEDIMENT SAMPLING AT MDA G

Media	# of Samples	# of QCs Samples[a]	Total Samples	Analysis
Soil	81	20	101	VOCs SVOCs Metals Pesticides PCBs Cyanide ROCs[b]

(a) Includes Trip Blank, Field Blank, Duplicate Sample, and Equipment (Rinsate) Blank.

Trip Blank: Two 40 ml VOC sample containers filled with organic-free water at the Sample Coordination Facility. Filled trip blanks accompany sample bottles to the field, remain unopened throughout the sampling activity, and return with shipment to the analytical laboratory. Submitted only when sampling for VOCs.

Field Blank: Organic-free water is poured into sample containers at the sampling site.

Duplicate Sample: Collect two separate soil samples simultaneously.

Equipment (Rinsate) Blank: Obtained by running organic-free water over cleaned, decontaminated sampling equipment. Rinse the equipment surface that comes into contact with a sample.

(b) Radionuclides of Concern (ROCs) for OU 1148 (see Table 5.4-18).

5.4.4.2.7 Phase II SAP

Phase II sampling of surface sediment will be conducted at MDA G to determine the vertical and lateral extent of any COCs detected during the Phase I sampling that exceeded health risk-based criteria. Samples will be collected from 6 to 12 in below the 27 locations that had the highest concentrations of COCs during Phase I sampling. The Phase II sampling will provide data for health risk assessments. Table 5.4-23 summarizes the number of samples and the analytical requirements for the Phase II sampling activities. The Phase II plan outline in this table may be modified, as appropriate, after results of Phase I sampling are reviewed.

5.4.4.2.8 Health and Safety

This SAP will follow the procedures outlined in the Laboratory's Environment, Safety and Health Manual (LANL 1990, 0335) and Annex III of this RFI Work Plan.

5.4.4.2.9 Schedule

See Annex I.

5.4.4.3 Vertical Borehole Sampling at MDA G

5.4.4.3.1 Sampling and Analysis Components

The purpose of collecting and analyzing samples from boreholes at MDA G is to collect technically accurate and legally defensible data which can be used to characterize the nature of any contaminant releases at MDA G. The sampling component of this task consists of drilling vertical boreholes to collect continuous rock core samples and soil gas samples for chemical and radiological analyses. The analytical component consists of field and laboratory analysis of rock core and soil gas samples. Soil gas samples will be screened in the field for VOCs. Rock core samples will be screened in the field for VOCs, gross alpha, gross beta, and gross gamma ionizing radiation. Analysis at a LANL-contracted analytical laboratory will be conducted on core samples for VOCs, SVOCs, metals, pesticides, PCBs, cyanide, and ROCs (see Table 5.4-18). Soil gas samples will be analyzed at a contract laboratory for VOCs. The data will be validated according to EPA functional guidelines for organic analysis (EPA 1988, 0293) and inorganic analysis (EPA 1988, 0296). Currently, there are no published EPA methods for validating all radionuclide analyses.

TABLE 5.4-23
PHASE II SURFACE SEDIMENT SAMPLING AT MDA G

Media	Locations	Rationale	Analysis	# of Samples
Sediment	27 locations	Sample to determine the extent of contamination.	COCs	27 + 8 QCs 35 Total

5.4.4.3.2 Sampling and Analysis Approach

A phased drilling approach will be used to characterize subsurface contamination at MDA G. Rock core and soil gas samples will be collected from the proposed Phase I boreholes. A continuous suite of rock core samples will be collected using hollow stem auger drilling techniques. Soil gas samples will be collected from sections of the borehole isolated and sealed by a packer. Samples of soil gas will be collected using the TO-14 gas canister method (SUMMA®) in the grab sample mode, or a resin tube method currently under development by the Laboratory's EM-9 Group.

Rock core and soil gas samples will be shipped to a Laboratory-contracted environmental laboratory for analysis. All analyses for hazardous constituents will be performed according to EPA SW-846 (third edition) protocol. Analyses with Tentatively Identified Compounds (TICs) will be reported in Level III SW-846 packages for subsequent data validation. Analysis for radionuclides will be reported in data packages formatted to LANL requirements for the off-site laboratory statement of work.

5.4.4.3.3 Primary Data Quality Factors

5.4.4.3.3.1 Prioritized Data Uses

- Site characterization - There is a data base for VOCs from four existing wells at MDA G. However, the data do not include all of the regulated volatile organic compounds. Existing data have not been validated in accordance with the EPA functional guidelines. The data base does not include data for SVOCs, metals, pesticides, PCBs, cyanide, or ROCs. Data will be collected to fill existing data gaps and to support the validity and use of the existing data base.

- Risk Assessment - The source term is not fully understood because the exact chemical constituents and quantities that were disposed of in MDA G are unknown. The locations of potential sources of contamination, the rate of organic vapor generation, and the flux emanating from the site are also unknown. Data will be collected to help determine the nature and extent of any residual rock contamination at MDA G, and the potential contribution to environmental transport and exposure pathways.

5.4.4.3.3.2 Appropriate Analytical Levels

Samples collected will be screened in the field and analyzed in a laboratory using SW-846 (third edition) protocol. PIDs, FIDs, and ECDs will be used in the field to screen for organic vapors immediately after samples have been collected. A field Gas Chromatograph (GC), in a mobile laboratory, will be used along with a PID or FID to determine qualitatively the hazardous constituents present.

Radiological screening of samples will be conducted for gross beta and gamma radioactivity and gross alpha contamination. Screening for gross beta and gamma

radioactivity will be conducted with a hand-held sodium iodide detector (NaID) probe and rate meter, or equivalent system. Screening for gross alpha contamination will be conducted with a hand-held alpha scintillation detector (ASD) and rate meter, or equivalent system. A windowless gas flow proportional (GFP) counter and a liquid scintillation counter in a mobile laboratory will be used to detect for the presence of radionuclides, in addition to screening with the hand-held detectors. The analytical levels include:

Level I Field Screen: PID/FID Instruments; NaID/ASD Instruments,

Level II Field Analysis: Field GC with a PID, FID, or ECD; Windowless GFP Counter; Liquid Scintillation Counter,

Level III SW-846 Laboratory Methods, and

Level V Radiological Analysis Laboratory Methods.

5.4.4.3.3.3 Primary Contaminants of Concern

The primary contaminants of concern at MDA G are VOCs, SVOCs, metals, pesticides, PCBs, cyanide, and ROCs (see Table 5.4-18).

5.4.4.3.3.4 Levels of Concern

Appendix F of the IWP (LANL 1991, 0553) and 40 CFR 264, Proposed Subpart S, contain information on constituent levels of concern. Health risk-based determinations of levels of concern will be developed for constituents not listed in Appendix F. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 IWP. This approach will be developed in adequate time for data analysis.

5.4.4.3.3.5 Required Quantitation Limits

Quantitation limits for laboratory analysis of hazardous substances and radionuclides are presented in Tables V.3 through V.9 of the Laboratory's Generic QAPjP (LANL 1991, 0412).

5.4.4.3.3.6 Critical Samples

Samples collected from the vertical boreholes at the distal edge of the source are important in determining the nature and extent of contamination. These samples are critical in the design of future corrective actions. Samples collected from boreholes placed in areas of potential or known contamination are important in detecting and characterizing contaminant releases. Samples collected from the surge bed are important in determining if it is a primary contaminant migration pathway. The locations of the five proposed vertical boreholes are shown on Figure 5.4-9.

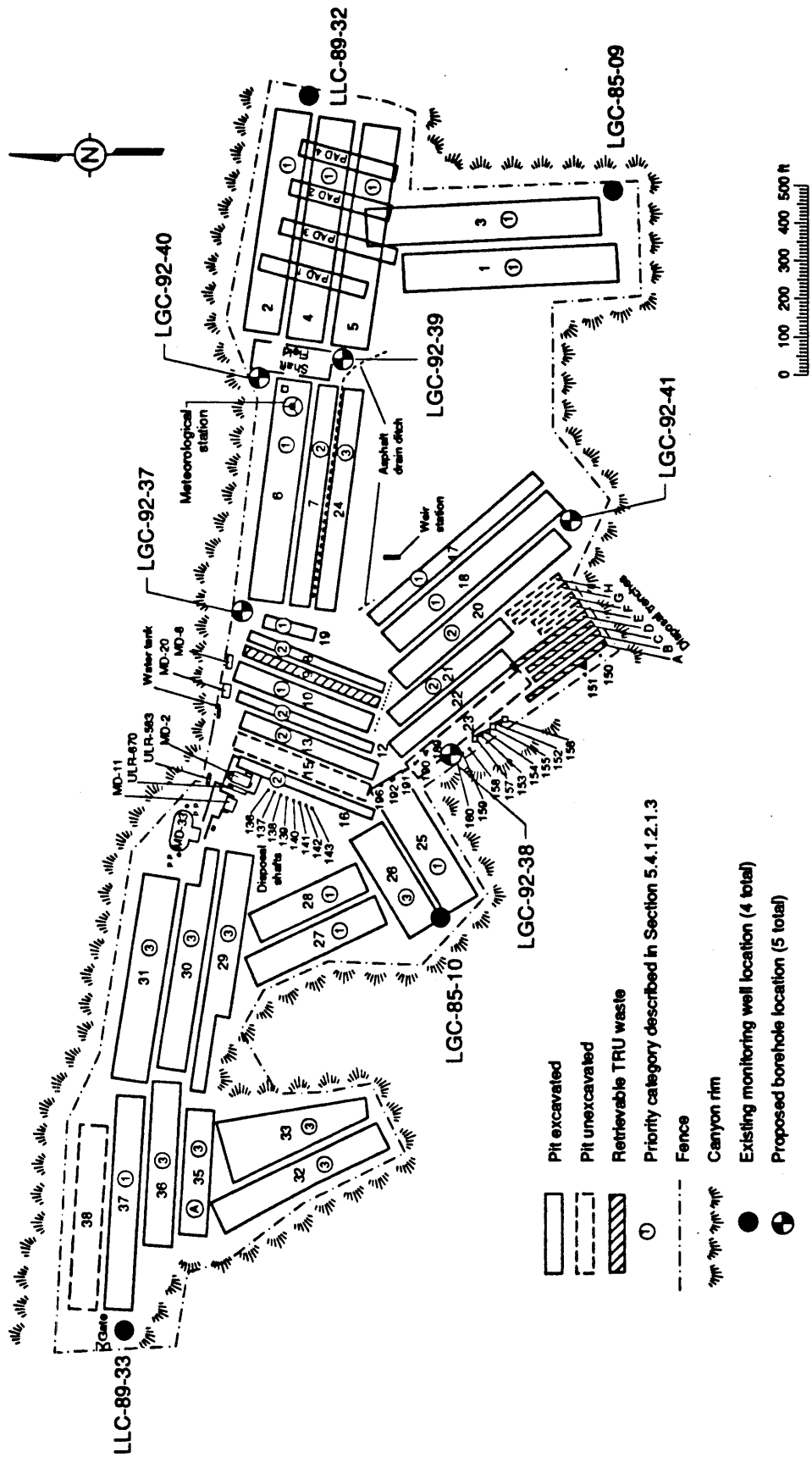


Figure 5.4-9 Location map of proposed vertical boreholes and vapor-monitoring wells at MDA G.

One borehole (LGC-92-37) will be located north of Pit 19 to investigate for potential contaminant release from the truck washing pit. The second borehole (LGC-92-38) will be south of Shafts 189, 190, 191, 192, and 196 along the perimeter fence. These shafts are unlined and contain Los Alamos Meson Physics Facility (LAMPF) waste. The third borehole (LGC-92-39) will be located just south of the shaft field in the eastern part of MDA G. The fourth borehole (LGC-92-40) will be located on the northern perimeter of the MDA north of the field of shafts. Very little is known about the material disposed of in this section of MDA G. However, high-level tritium was disposed of in some of the shafts. A tritium plume was detected in this area in 1970. The fifth borehole (LGC-92-41) is located on the southern perimeter of the MDA, south of Pits 17, 18, and 20. Wastes with a high liquid content were disposed of in Pit 20, and Pits 17 and 18 are high priority pits (see Section 5.4.1.2.1.3).

5.4.4.3.4 Rationale for Sampling Activity

The rationale for installing boreholes and vapor monitoring wells is to:

- determine the nature and extent of any residual soil or rock contamination;
- determine the source term for any residual soil or rock contamination; and
- collect data that can be validated according to EPA functional guidelines for data validation and that can be used to support the use of existing data.

Data obtained through implementation of the Phase I SAP will be used for the initial characterization of the nature, extent, and source of any residual soil or rock contamination at MDA G. This information will be obtained through the following sampling tasks:

Task 1. Borehole Installation

- Five vertical boreholes will be installed to determine the nature and extent of any residual soil or rock contamination (see Figure 5.4-9 for the proposed borehole locations).
- Core samples will be collected and analyzed for VOCs, SVOCs, metals, pesticides, PCBs, cyanide, and ROCs by a contract analytical laboratory that is certified to perform SW-846 analyses.
- Soil gas samples will be collected in resin tubes or in SUMMA® canisters as the boring is advanced and analyzed for VOCs by a contract analytical laboratory that is certified to perform SW-846 analysis.

Task 2. Vapor Monitoring Wells

- Five vapor monitoring wells will be installed in the constructed boreholes (see Figure 5.4-9 for borehole locations).
- Soil gas samples will be collected in resin tubes or SUMMA® canisters and analyzed for VOCs by an EPA-approved SW-846 laboratory.

5.4.4.3.5 Sampling Activity

5.4.4.3.5.1 Boreholes at MDA G

Five vertical boreholes will be installed during the Phase I sampling program. These boreholes will be drilled to a depth of approximately 100 feet. The boreholes will be advanced to a depth necessary to intercept and drill 10 feet beyond the surge bed (a permeable geologic feature), estimated to be 60 feet deep beneath MDA G. The actual depth of the vertical boreholes may vary depending on the results of field analysis on soils, rock core, and soil gas. All vertical boreholes will be advanced until no radiological contaminants or VOCs are detected by field analysis techniques. Vapor monitoring wells will be installed in each of the five vertical boreholes.

The locations of the five proposed boreholes/vapor monitoring wells are shown on Figure 5.4-9. Table 5.4-24 is a sampling summary of the vertical boreholes at MDA G. It lists the sampling interval for each media along with the analyses to be performed and the corresponding analytical level. A detailed tabulation of sample intervals and corresponding analyses for each borehole is presented in Table B.3-4 of Appendix B. The ratio for QC samples for sample collection activities is presented in Table B.10-1 of Appendix B. Table 5.4-25 summarizes the number of field samples, the number of QC samples, and the analytical requirements for the Phase I sampling at MDA G, and explains the types of QC samples required.

The procedures for borehole installation and logging, sample (rock core) collection from the vertical boreholes, field screening analysis, hydrogeologic measurements, downhole geophysical surveys, and waste disposal and borehole abandonment are described in Section 3.0 of Appendix B. Vapor monitoring well installation, soil gas sampling procedures, surveying and monitoring, and field screening procedures are presented in Section 6.0 of Appendix B.

5.4.4.3.6 Remaining SAP Elements

The remaining required elements of this SAP are common to all of the SAPs prepared for OU 1148. These common elements are listed in Table 5.4-20 and are located in Appendix B of this RFI Work Plan.

5.4.4.3.7 Phase II SAP

Four additional boreholes will be installed during Phase II sampling. These boreholes will be located outside of the MDA G boundary to determine the vertical and horizontal extent of any contaminant plumes. The Phase II boreholes will be drilled to a depth of approximately 200 feet. Samples will be collected at each 20-foot interval, and analyzed for the COCs that exceeded health risk-based criteria during Phase I sampling. Table 5.4-26 summarizes the Phase II sample and analytical requirements.

TABLE 5.4-24
SAMPLING SUMMARY FOR
VERTICAL BOREHOLES AT MDA G

Analytical Level	Sampling Interval	Analysis	Medium
Laboratory Analysis[a]			
Level III	20 ft	VOCs	Rock Core
Level III	20 ft	SVOCs	Rock Core
Level III	20 ft	Metals	Rock Core
Level III	20 ft	Pesticides, PCBs, Cyanide	Rock Core
Level III	20 ft	VOCs	Vapor
Level V	20 ft	ROCs	Rock Core
Field Screening or Analysis			
Level I	5 ft	Organic Vapors (PID/FID)	Rock Core
Level II	5 ft	Organic Vapors (Field GC)	Rock Core
Level I or II	5 ft	Alpha, Beta, & Gamma Emissions	Rock Core
Level II	5 ft	Tritium	Rock Core
Level II	5 ft	Gravimetric Moisture	Rock Core

[a] A sample will be collected at a minimum spacing of 20 ft for analysis to confirm the absence or presence of COCs above the health risk-based criteria. The actual depth of the sample will be determined from field screening and observation.

TABLE 5.4-25
PHASE I SAMPLING AND ANALYSIS PLAN TABLE FOR VERTICAL BOREHOLE SAMPLING AT MDA G

Media	# of Samples	# of QC[a] Samples	Total Samples	Analysis
Rock Core	30	40	70	VOCs SVOCs Metals Pesticides PCBs Cyanide ROCs[b]
Soil Gas	30	40	70	VOCs

(a) Includes Trip Blank, Field Blank, Duplicate Sample, and Equipment (Rinsate) Blank.

Trip Blank (Soil/Rock Core): Two 40 ml VOC sample containers filled with organic-free water at the Sample Coordination Facility. Filled trip blanks accompany sample bottles to the field, remain unopened throughout the sampling activity, and return with shipment to the analytical laboratory. Submitted only when sampling for VOCs.

Trip Blank (Soil Gas): A sealed SUMMA® canister or resin tubes taken to the field during a sampling event and returned with shipment to the analytical laboratory. Canister or resin tubes remain unopened.

Field Blank (Soil/Rock Core): Organic-free water is poured into sample containers at the site of the borehole sampling.

Field Blank (Soil Gas): A SUMMA® canister or resin tubes are exposed to the atmosphere near the sampling site. The canister or resin tubes will be left open until 3 liters of air are sampled.

Duplicate Sample (Soil/Rock Core): Collect two separate core samples immediately adjacent to each other by the same sampling technique.

Duplicate Sample (Soil Gas): Obtained by attaching two SUMMA® canisters or four resin tubes to the sample line with a "Y" fitting and filling the canisters or tubes simultaneously.

Equipment (Rinsate) Blank (Soil/Rock Core): Obtained by running organic-free water over cleaned, decontaminated sampling equipment. Rinse the equipment surface that comes into contact with a sample.

Equipment (Rinsate) Blank (Soil Gas): A gas sample, using a SUMMA® canister or resin tubes, is taken to assess the cleanliness of the sample manifold. Clean the sample manifold, fill a 6L Teflon® bag with zero-zero air, and attach the bag and a canister or resin tubes to the manifold. Collect 3 liters using a flow rate of 500 ml/minute.

(b) Radionuclides of Concern (ROCs) for OU 1148 (see Table 5.4-18).

TABLE 5.4-26
PHASE II BOREHOLE SAMPLING AT MDA G

Media	Phase II Sampling	Rationale	Analysis	# of Samples
Rock Core	4 Locations	Sample to further characterize the lateral and vertical extent of subsurface contamination from MDA G.	COCs	44 + 64 QCs 108 Total
Soil Gas	4 Locations	Sample to further characterize the lateral and vertical extent of subsurface contamination from MDA G.	VOCs	44 + 64 QCs 108 Total

5.4.4.3.8 Health and Safety

This SAP will follow the procedures outlined in the Laboratory's Environment, Safety and Health Manual (LANL 1990, 0335) and Annex III of this RFI Work Plan.

5.4.4.3.9 Schedule

See Annex I.

5.4.4.4 Existing Vapor Monitoring Wells Sampling at MDA G

5.4.4.4.1 Sampling and Analysis Components

The purpose of sampling and analyzing soil gas from the existing vapor monitoring wells at MDA G is to accumulate technically accurate and legally defensible data. The data will be used to characterize the horizontal and vertical extent of the vapor plume beneath MDA G and the in situ source term. Additionally, the data will be used to determine the effects of purge volumes on measured concentrations and to confirm the existing data. The data will be validated according to EPA functional guidelines for organic analysis (EPA 1988, 0293).

5.4.4.4.2 Sampling and Analysis Approach

A predetermined volume of soil vapor from the access tubing for vapor monitoring wells LGC-85-09 and LGC-85-10 will be purged and a sample of gas will then be collected using resin tubes or the EPA TO-14 gas canister method (SUMMA®) in the grab sample mode. The grab sample mode uses a flow controller (or flow meter) and a vacuum gauge manifolded between the well sample tubing and the canister. Soil vapor samples will also be collected from vapor monitoring wells LGC-85-32, LGC-85-33, and the vertical boreholes installed during this investigation (see Section 5.4.4.3). After collection, the samples will be shipped to a qualified environmental laboratory for analysis of VOCs according to EPA SW-846 (third edition) protocol, with TICs reported in Level III SW-846 packages for subsequent data validation.

5.4.4.4.3 Primary Data Quality Factors

5.4.4.4.3.1 Prioritized Data Uses

The data to be collected are needed for site characterization and risk assessment calculations. Each stage of data collection and use is outlined below:

- Site Characterization - A data base already exists for MDA G; however, the data do not include all of the regulated VOC compounds and have not been validated according to EPA functional guidelines. New data will be

collected to support the use of the existing data and to further characterize the nature and extent of the vapor plume.

- Risk Assessment - The characteristics of the VOC plume are not clear because the chemical constituents placed in MDA G are unknown, as are the quantities and emanation fluxes of volatile constituents. Data will be collected to determine the identities and rates of migration of vapors in the plume, and to determine the significance of this transport pathway for future exposure and risk assessments.

5.4.4.4.3.2 Appropriate Analytical Levels

Samples will be screened in the field for VOCs and analyzed for VOCs by a laboratory using SW-846 protocol. PIDs, FIDs, and ECDs will be used in the field to screen for organic vapors immediately after samples have been collected. A field GC, in a mobile laboratory, may be used along with a PID or FID to quantitatively determine the constituents present. The analytical levels include:

Level I	Field Screen: PID/FID Instruments,
Level II	Field Screen: Field GC with a PID/FID or ECD, and
Level III	SW-846 Laboratory Methods.

5.4.4.4.3.3 Primary Contaminants of Concern

The contaminants of concern at MDA G for this sampling activity are VOCs.

5.4.4.4.3.4 Levels of Concern

Appendix F of the IWP (LANL 1991, 0553) and 40 CFR 264, Proposed Subpart S, contain information on constituent levels of concern. Health risk-based determinations of levels of concern will be developed for constituents not listed in Appendix F. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 IWP. This approach will be developed in adequate time for data analysis.

5.4.4.4.3.5 Required Quantitation Limits

Quantitation limits are not established for soil gas vapor monitoring. Table V.3 of the Laboratory's Generic QAPjP, however, gives quantitation limits for laboratory analysis of VOCs in soil and water (LANL 1991, 0412).

5.4.4.4.3.6 Critical Samples

Results of previous sampling and analysis efforts at the existing boreholes do not include analyses of the full suite of VOCs and TICs according to SW-846 protocol. Accordingly, these existing wells will be resampled. Samples collected at the distal edge of the source, both vertically and horizontally, are important in determining the nature and extent of the plume. These samples are critical in determining future corrective action.

5.4.4.4.4 Rationale For Sampling Activity

The reasons for sampling the existing vapor monitoring wells at MDA G are:

- to further define the physical nature and extent of the vapor plume;
- to further define the source term of the vapor plume; and
- to collect data that may support use of the existing data and that can be validated according to EPA functional guidelines for data validation.

All data will be validated according to the EPA functional guidelines for organic analysis (EPA 1988, 0293). This will provide the highest quality data for vapor plume characterization.

5.4.4.4.5 Sampling Activity

The four existing vapor monitoring wells and the five new vapor monitoring wells installed during this investigation (see Section 5.4.4.3) will be sampled to identify the horizontal and vertical extent of the VOC vapor plume and to compare the data with existing information. The locations of the existing vapor monitoring wells at MDA G are shown on Figure 5.4-10; the locations of the wells installed during this investigation are shown on Figure 5.4-9 as "proposed borehole locations." Table 5.4-27 lists, by well number, the sample interval depths and purge volumes for each sample to be collected for a purge volume study. For this study, a sample will be collected at each sample port (7 total samples) from wells LGC-85-09 (4 samples) and LGC-85-10 (3 samples). The number of soil gas samples to be collected from the remaining two existing monitoring wells will be determined in the field, and the number of samples to be collected from the wells installed during this investigation will be determined after the wells are installed. Samples will be analyzed for EPA SW-846 VOCs (51 organic compounds).

Resin tubes or SUMMA® six-liter canisters will be used to collect soil gas vapor from the vapor monitoring wells in MDA G. The laboratory providing the precleaned, subatmospheric depressurized SUMMA® canisters will supply certificates of cleanliness for the canisters. Resin tube vendors will supply similar certificates, along with lot numbers. All sample SUMMA® canisters or resin tubes and quality control (QC) samples will be filled with three liters of atmosphere. Soil gas sampling procedures are described in Section 6.0 of Appendix B. Table 5.4-28 lists the number of

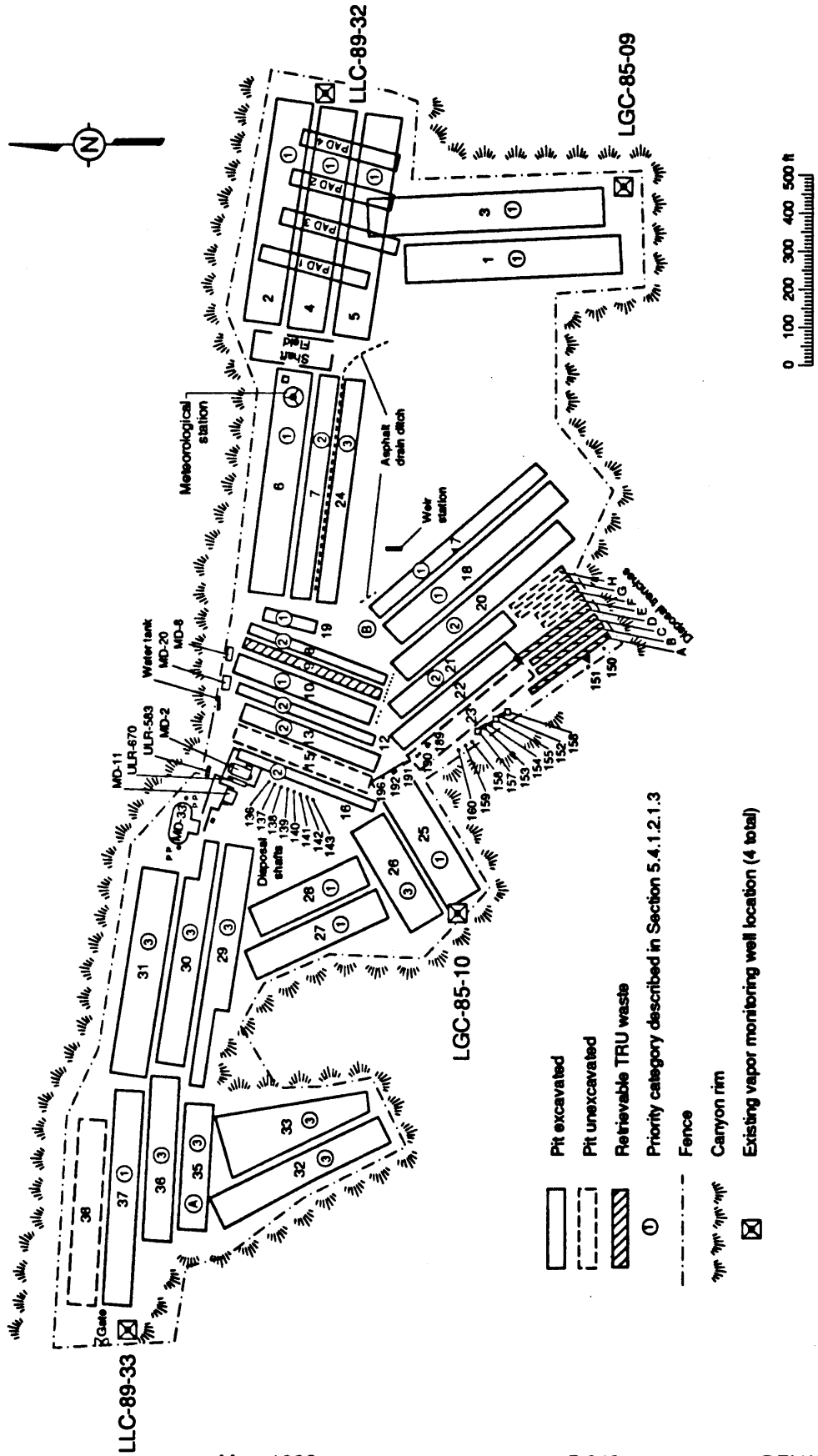


Figure 5.4-10 Location map of existing vapor monitoring wells at MDA G.

TABLE 5.4-27
PURGE VOLUMES FOR VAPOR MONITORING WELLS AT MDA G

Well Number	Sample Interval Depth (in feet below surface)	Purge Volumes[a] (in ml)
LGC-85-09	37	185
	63	315
	80	400
	93	465
LGC-85-10	30	150
	53	265
	95	475

[a] 1 linear foot = 5 ml

TABLE 5.4-28
PHASE I SAMPLING AND ANALYSIS PLAN TABLE FOR EXISTING VAPOR MONITORING WELL SAMPLING AT MDA G

Media	# of Samples	# of QC[a] Samples	Total Samples	Analysis
Soil Gas with SUMMA® canister or resin tubes	7[b]	4[b]	11[b]	VOCs

[a]Includes Trip Blank, Field Blank (Ambient Sample), Duplicate Sample, and Equipment (Sample Manifold) Blank.

Trip Blank: A SUMMA® canister or resin tubes are taken to the field during a sampling event and then shipped back to the analytical laboratory along with the field samples. The trip blank will remain unopened both from and to the laboratory.

Field Blank (Ambient Sample): A SUMMA® canister or resin tubes are exposed to the atmosphere near the sampling site to assess the atmosphere at the site. Lever the canister or resin tubes open for the time period required to take three liters of air sample.

Duplicate Sample: A field duplicate of soil gas obtained by attaching two canisters or four resin tubes to the sample ling using a Y fitting. Canisters or resin tubes are filled simultaneously.

Equipment (Sample Manifold) Blank: A sample taken using a SUMMA® canister or resin tubes to assess the cleanliness of the sample manifold. Clean and decontaminate the sample manifold and fill a six-liter Teflon® bag with zero-zero air. Attach the bag and canister or resin tubes to the manifold and collect three liters of air using a flow rate of 500 ml/min.

[b]Does not include the number of samples to be collected from LGC-85-09, LGC-85-10, and the newly-installed vapor monitoring wells (see Section 5.4.4.3).

samples, the number of QC samples, and the analytical requirements for the Phase I sampling activity. It also describes the types of required QC samples.

Sampling events will be based on time of maximum vertical gas movement and will occur once during a cool season (March, April, or May), and once during the following warm months (June, July, or August). The samples will be collected during that time period. Refer to Section 5.4.4.5.2 for a discussion of the influence of earth tides on vertical gas movement.

5.4.4.4.6 Remaining SAP Elements

The remaining required elements of this SAP are common to all of the SAPs prepared for OU 1148. These common elements are listed in Table 5.4-20 and are located in Appendix B of this RFI Work Plan.

5.4.4.4.7 Phase II SAPs

No additional sampling of the existing monitoring wells will be conducted under this RFI Work Plan. Additional sampling will be conducted as part of the requirements of LANL's RCRA Operating Permit, Section B, Special Permit Conditions, Vadose Zone Research at TA-54 (Permit Number NM890010515, page 6).

5.4.4.4.8 Health and Safety

This SAP will follow the procedures outlined in the Laboratory's Environment, Safety and Health Manual (LANL 1990, 0335) and Annex III of this RFI Work Plan.

5.4.4.4.9 Schedule

See Annex I.

5.4.4.5 Passive Air Sampling at MDA G

5.4.4.5.1 Sampling and Analysis Components

The purpose of collecting and analyzing passive air samples at MDA G is to accumulate technically accurate and legally defensible data. The data will be used to characterize the nature, type, and extent of contamination by VOCs at MDA G. This information will be used in the Phase I assessment to determine the flux rate of VOCs emanating from MDA G. MDA G has four existing vapor monitoring wells which have VOCs present in µg/L (gas) concentration.

The sampling components will consist of collection of passive air samples at the ground surface using EMFLUX® sample cartridges. The analysis component will

consist of VOC analysis by Quadrel Services Inc. The data will be validated according to EPA functional guidelines for organic analysis (EPA 1988, 0293).

5.4.4.5.2 Sampling and Analysis Approach

Soil gas will be sampled using EMFLUX® sample cartridges, which are stainless steel mesh and wire cartridges containing approximately 100 mg of selected adsorbent material. The sample cartridges will be placed at surveyed sampling points on a predetermined grid. Cartridges will be exposed to the soil for a period of 72 hours in order to capture soil gas by passive adsorption. To increase survey sensitivity and accuracy, the EMFLUX® system is designed to take maximum advantage of the phenomenon known as earth tides, the dominant geophysical forces governing vertical movement of trace gases through the earth's crust. Variation in barometric pressure is also important to outgassing of soil gas to the atmosphere. Therefore, barometric pressure will be monitored before, during, and after the sampling period. The sampling window will be synchronized with a period of low atmospheric pressure, if possible. Wind speed will also be collected from the MDA G weather tower.

The samples will be sent to the Sample Coordination Facility (SCF), where they will be shipped to Quadrel Services Inc. environmental laboratories for analysis. The analysis to be performed include VOCs, following EPA SW-846 (third edition) protocol with ten compound library search and TICs. Results will be reported in Level III SW-846 packages for subsequent data validation.

5.4.4.5.3 Primary Data Quality Factors

5.4.4.5.3.1 Prioritized Data Uses

The data to be collected are needed for site characterization and risk assessment calculations. Each stage of data collection and use is outlined below:

- Site Characterization - A data base from four vapor monitoring wells already exists for MDA G; however, the data do not include all of the regulated VOC compounds. Passive air sampling is an inexpensive, nonintrusive means of collecting data in and surrounding MDA G. Passive air sampling will be used to determine the nature and extent of VOCs emanating from the ground to the atmosphere.

- Risk Assessment - The identities, quantities, and mobilities of VOCs at MDA G are not well documented. The results of passive air sampling will be used to estimate the total flux emanating from MDA G. These data will be used to determine the significance of the air transport pathway and inhalation exposure pathway in future risk assessments.

5.4.4.5.3.2 Appropriate Analytical Levels

Immediately after scoring the soil for placement of the sample cartridge, the soil surface will be screened for organic vapors with PIDs, FIDs, or ECDs. Screening for radionuclides will be conducted with a hand-held ASD for gross alpha contamination, and a hand-held NaID for gamma radioactivity. The various analytical levels established for this work plan are as follows:

Level I Field Screen: PID/FID Instruments; NaID/ASD Instruments,

Level II Field Analysis: Field GC with a PID/FID/ECD; Windowless GFP Counter, Liquid Scintillation Counter,

Level III SW-846 Laboratory Methods, and

Level V Radionuclide Analysis Laboratory Methods.

5.4.4.5.3.3 Primary Contaminants of Concern

The primary contaminants of concern at MDA G for this sampling activity are VOCs.

5.4.4.5.3.4 Levels of Concern

Appendix F of the IWP (LANL 1991, 0553) and 40 CFR 264, Proposed Subpart S, contain information on constituent levels of concern. Health risk-based determinations of levels of concern will be developed for constituents not listed in Appendix F. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 IWP. This approach will be developed in adequate time for data analysis.

5.4.4.5.3.5 Required Quantitation Limits

Quantitation limits are not established for soil gas vapor monitoring. Table V.3 of the Laboratory's Generic QAPjP, however, gives quantitation limits for laboratory analysis of VOCs in soil and water (LANL 1991, 0412).

5.4.4.5.3.6 Critical Samples

Samples collected at the ground surface are important in determining the nature and extent of VOCs emanating from the ground to the atmosphere. These samples are critical in determining future corrective action.

5.4.4.5.4 Rationale For Sampling Activity

The rationale for passive air sampling at MDA G is to further define the physical nature of organic vapor emanations from the MDA by using an inexpensive means

of multiple sampling. All of the data obtained through implementation of this SAP will be used in the Phase I site characterization of VOC emanations from MDA G. This information will be obtained through the following sampling tasks:

Task 1. Grid Layout and Sample Point Designation

The EPA "Field Manual for Grid Sampling of PCB Spill Sites to Verify Cleanup" (EPA 1986, 0645) was used in determining the grid layout and sample point designation for the passive air sampling task in MDA G. The manual provides guidance for designing hexagonal sampling grids which represent a statistically valid method for determining the extent of contamination from a chemical release.

MDA G was divided into eight separate areas for sampling purposes (Figure 5.4-11). Sampling grids were constructed for each of the eight areas following the procedures presented in the manual. Figures 5.4-12 through 5.4-15 illustrate the grid layout and the points to be sampled for each area.

Task 2. Source Term and Horizontal Characterization

A total of 162 surface locations will be sampled in Area G to identify the source term and horizontal extent of organic vapor emanations, as defined at the surface. One sample will be collected at each designated sampling point using EMFLUX® sample cartridges, and will be analyzed for VOCs (51 compounds) with a ten compound library search following EPA SW-846 protocol. The source term of any VOC emanations in Area G will be characterized by sampling the eight separate areas, each having its own sampling grid. The following tabulation lists the number of surface samples to be collected in each area:

Area	Number of Samples
G-1	16
G-2	19
G-3	19
G-4	14
G-5	19
G-6	24
G-7	23
G-8	28

Task 3. Data Reduction

All data will be validated according to the EPA functional guidelines for organic analysis (EPA 1988, 0293). This will provide the highest quality data for site characterization.

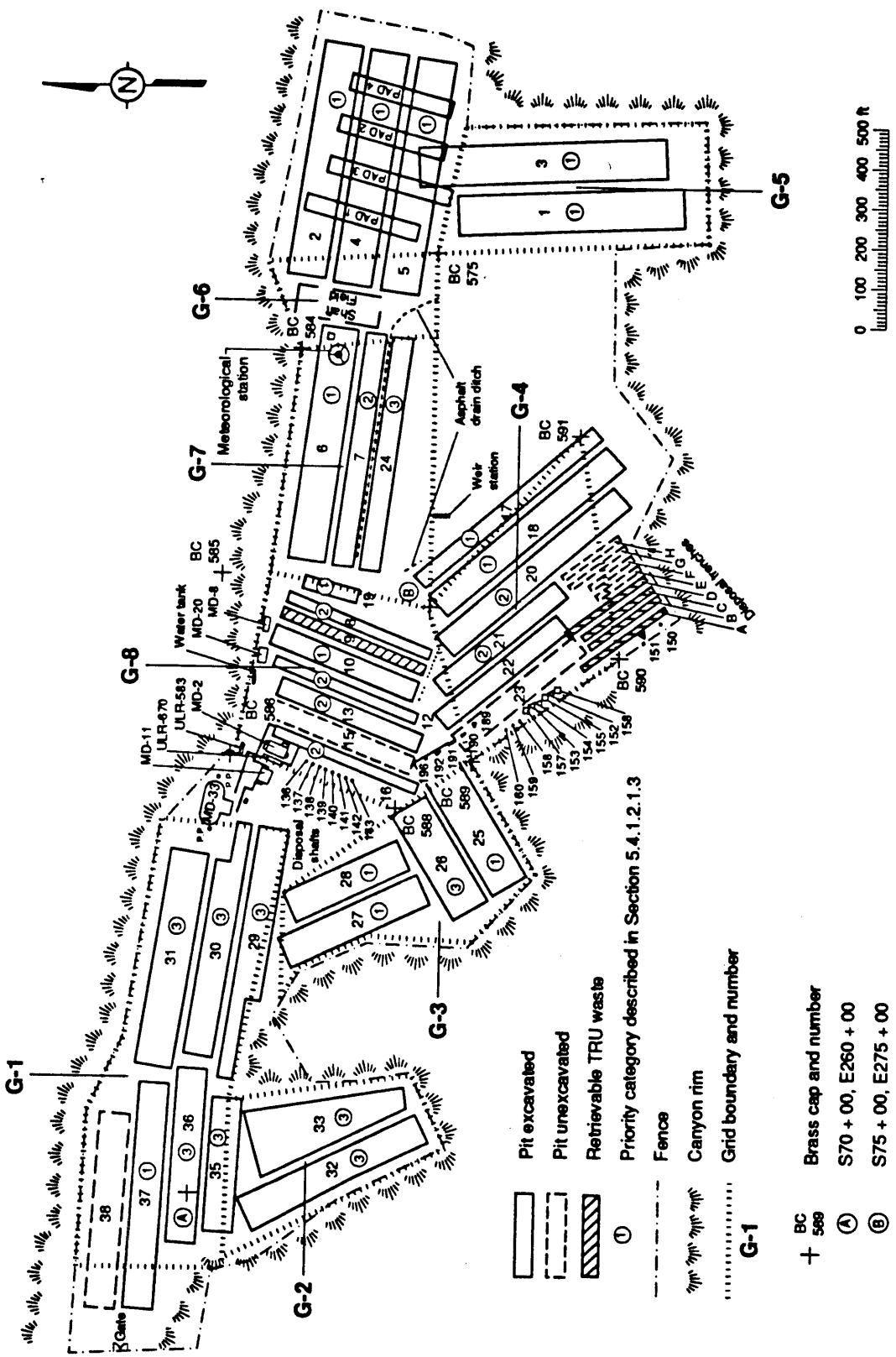


Figure 5.4-11 Location map of grid boundaries for passive air sampling at MDA G.

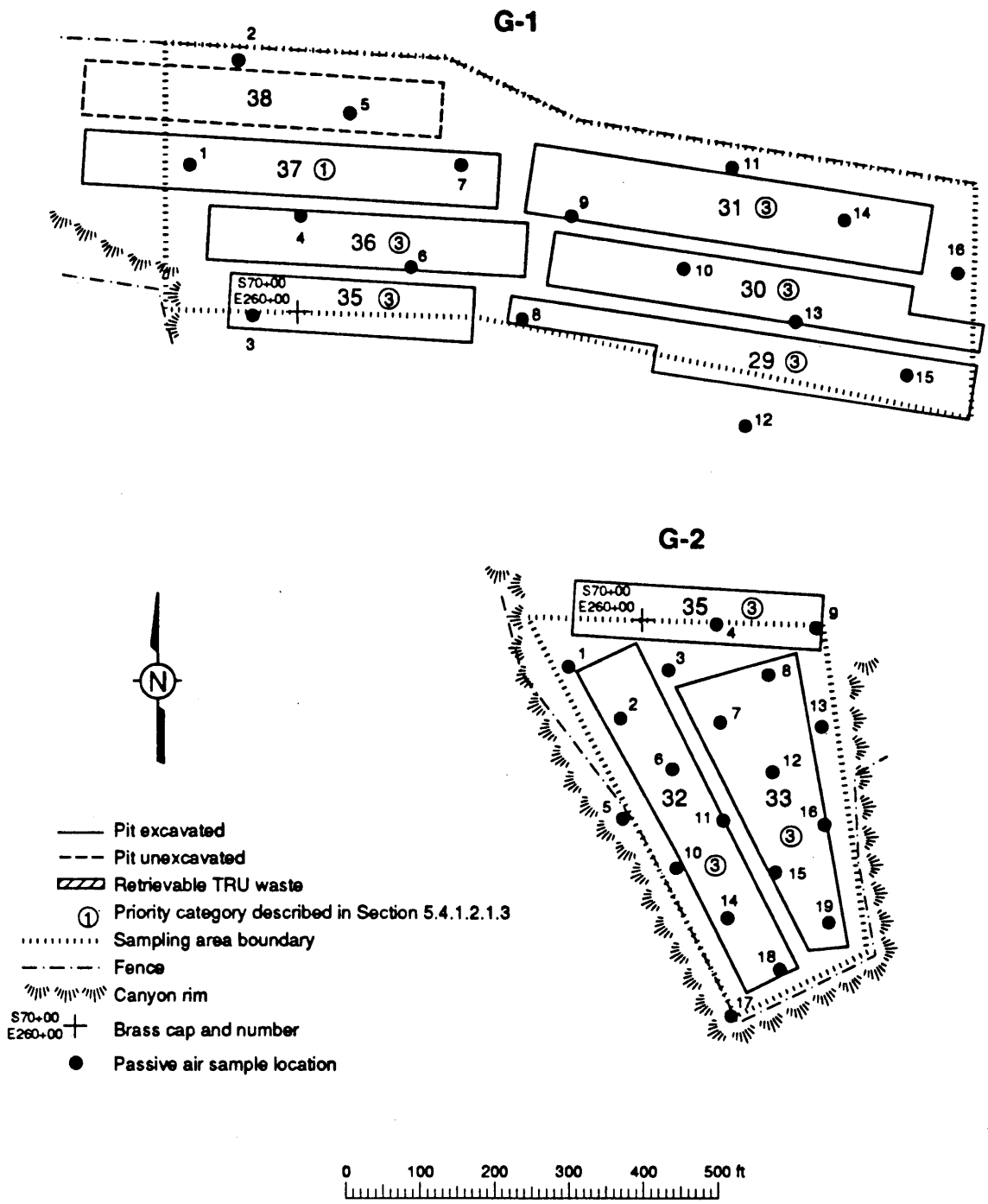


Figure 5.4-12 Location map of passive air samples in grids G-1 and G-2 at MDA G.

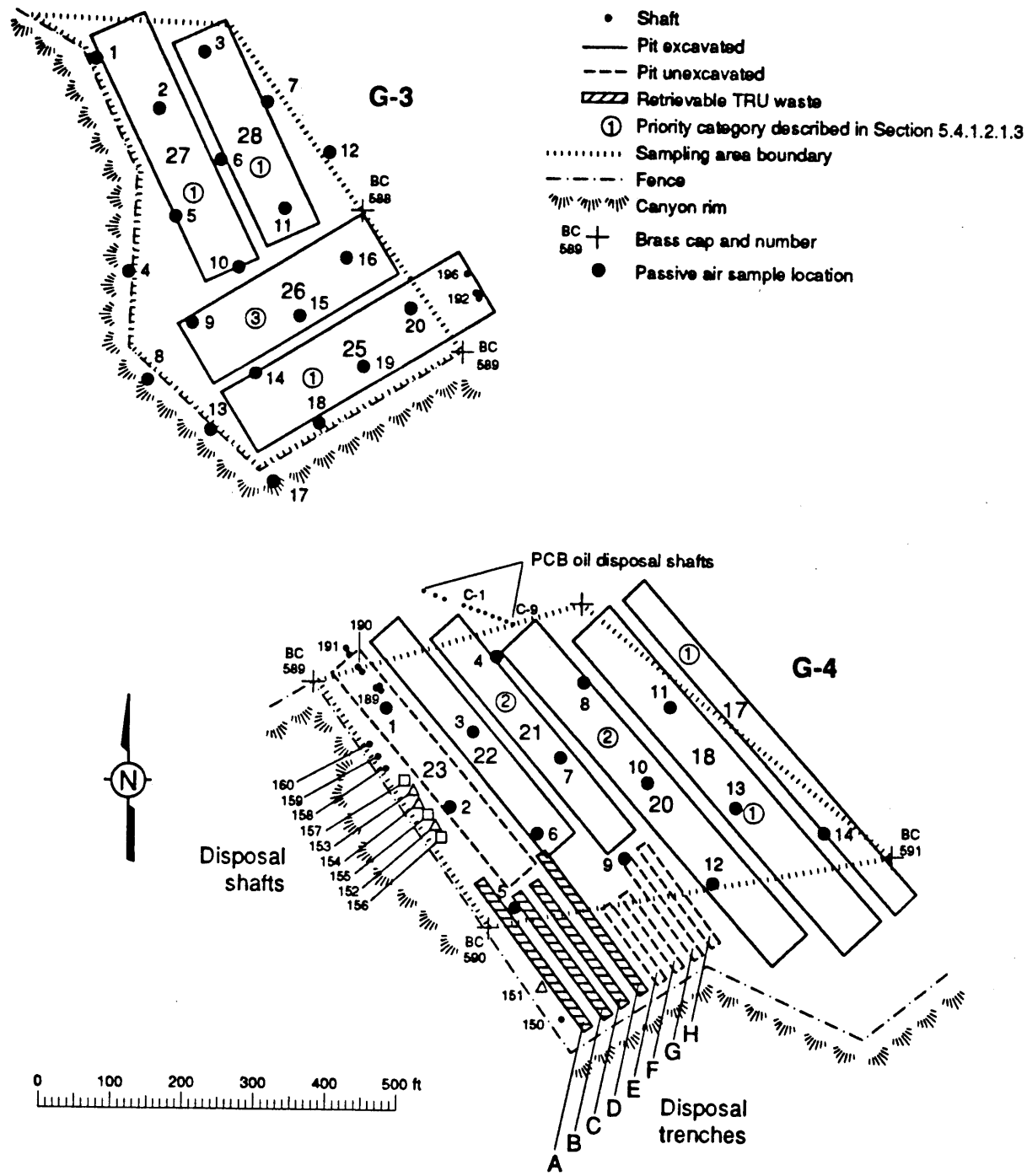


Figure 5.4-13 Location map of passive air samples in grids G-3 and G-4 at MDA G.

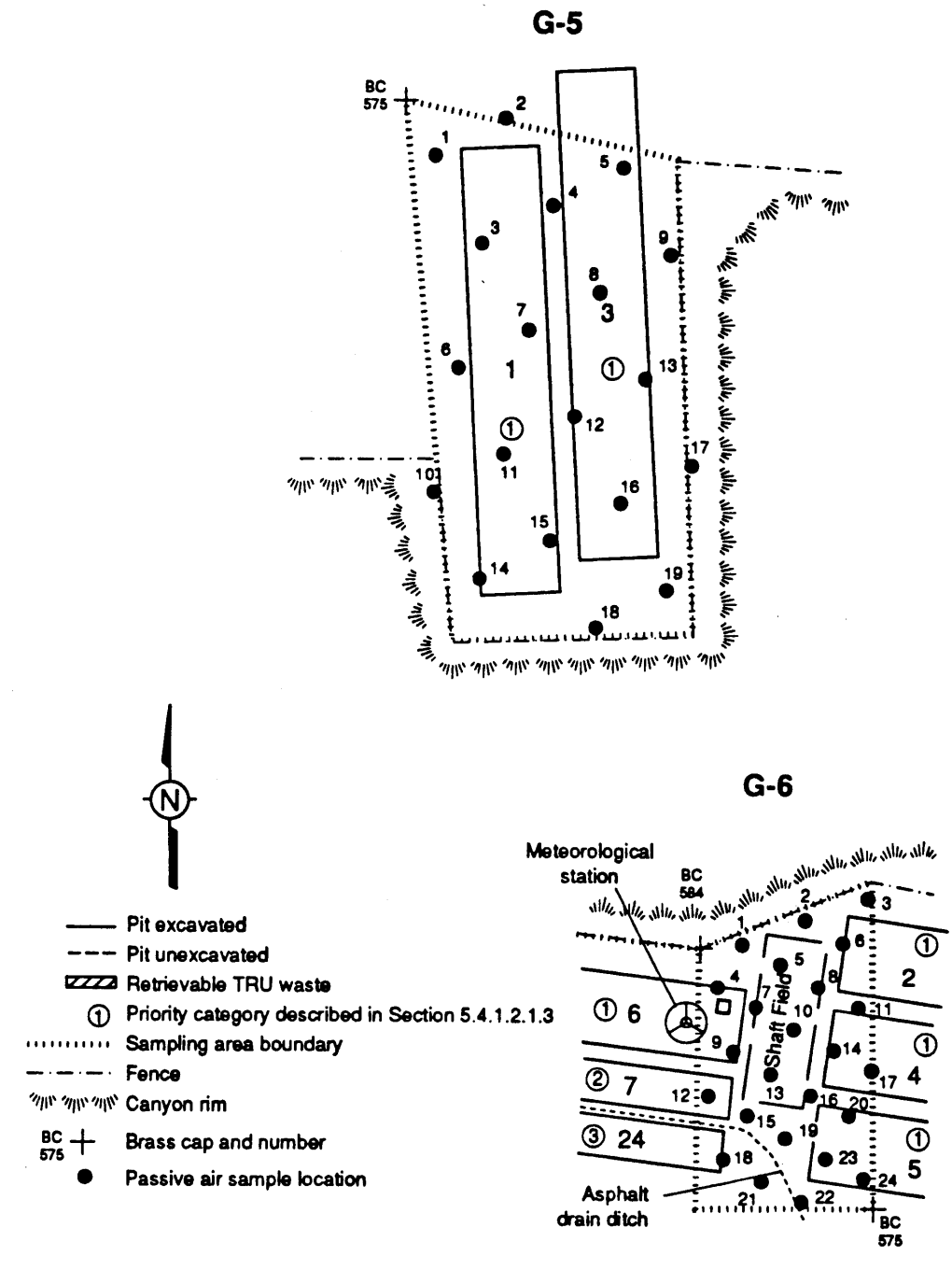


Figure 5.4-14 Location map of passive air samples in grids G-5 and G-6 at MDA G.

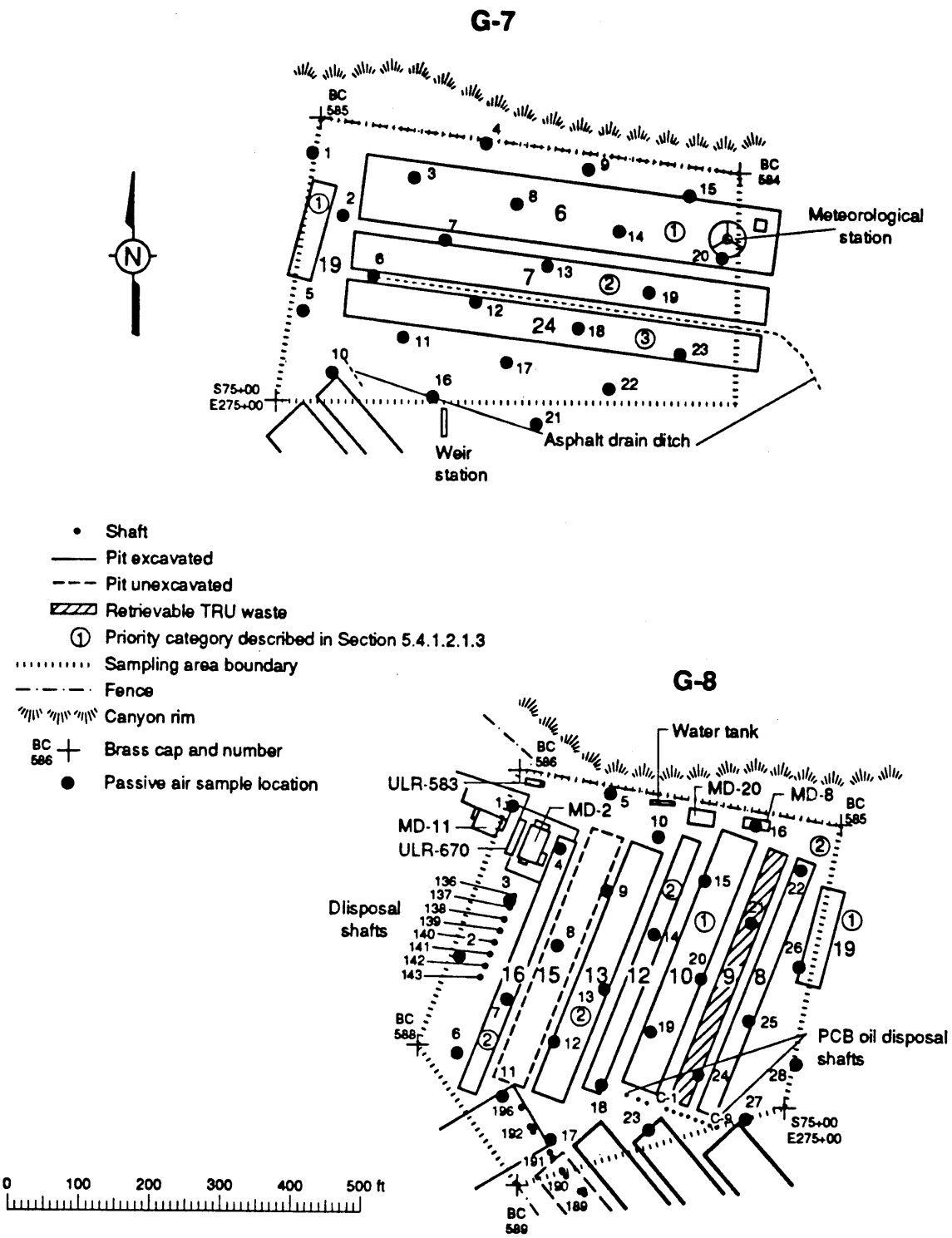


Figure 5.4-15 Location map of passive air samples in grids G-7 and G-8 at MDA G.

5.4.4.5.5 Sampling Activity

The locations of the 162 samples to be collected at MDA G are shown on Figures 5.4-12 through 5.4-15. A total of 324 samples will be collected (162 samples x 2 sampling events = 324). Table 5.4-29 lists the number of samples, the number of QC samples, and the analytical requirements for the Phase I investigation. It also describes the types of QC samples required.

EMFLUX®cartridges will be used to collect passive air samples in MDA G. The Quadrel Services Inc. laboratory, providing the precleaned cartridges, will supply certificates of cleanliness for the cartridges. All sample EMFLUX®cartridges will be left on site for a 72-hour period. If adsorption is allowed to continue for longer than 72 hours, breakthrough may occur.

Sampling events will be based on time of maximum vertical gas movement and will occur once during a cool season (March, April, or May), and once during the following warm months (June, July, or August). Periods of maximum vertical gas movement will be determined by Quadrel Services, Inc. The samples will be collected during that time period.

The timing of collector deployment and the length of the survey sampling period are critical elements of the EMFLUX®system. For each project, and well in advance of anticipated field work, Quadrel will furnish the date and hour by which all collection devices must be in place, using for this determination the company's computerized earth-tide/gas-migration model.

5.4.4.5.6 Remaining SAP Elements

The remaining required elements of this SAP are common to all of the SAPs prepared for OU 1148. These common elements are presented in Table 5.4-20 and are located in Appendix B of this RFI Work Plan.

5.4.4.5.7 Phase II SAP

Data collected during the proposed Phase I sampling effort will produce a "snapshot in time" to provide characterization of the VOC flux in MDA G. No Phase II sampling using this technique is proposed for the mesa top. However, based upon the results of the Phase I sampling, Phase II passive air sampling along the mesa walls may be conducted in the vicinity of MDA G. Ten locations on both sides of the mesa (20 total) may be sampled. Table 5.4-30 summarizes the Phase II passive air sampling plan for MDA G.

5.4.4.5.8 Health and Safety

This SAP will follow the procedures outlined in the Laboratory's Environment, Safety and Health Manual (LANL 1990, 0335) and in Annex III of this RFI Work Plan.

TABLE 5.4-29
PHASE I SAMPLING AND ANALYSIS PLAN TABLE FOR PASSIVE AIR SAMPLING AT MDA G

Media	# of Samples	# of QC[a] Samples	Total Samples	Analysis
Soil	162 (Spring)	35	197	VOCs
Gas	162 (Summer)	35	197	VOCs

[a]Includes Trip Blank, Field Blank, Duplicate Sample.

Trip Blank: An EMFLUX® cartridge that is taken to the field during a sampling event and then shipped back to the analytical contractor along with the field samples. The trip blank will remain unopened both from and to the laboratory.

Field Blank (Ambient or Control Point Sample): A sample taken to assess the ambient conditions at the sampling site. An EMFLUX® sampling device is set up on a control point barrier (3 or 4 layers of aluminum foil) near a designated sampling point and the cartridge exposed for the time period required for EMFLUX® sampling devices. One control point sample will be taken for every 10 samples.

Duplicate Sample: A field duplicate of a soil gas vapor sample is obtained by attaching two sample cartridges to the same cartridge stake. Both cartridges will be exposed simultaneously to the same soil gas sampling point and submitted to the analytical contractor through the SCF as consecutive samples.

TABLE 5.4-30
PHASE II PASSIVE AIR SAMPLING AT MDA G

Media	Phase II Sampling	Rationale	Analysis	# of Samples
Air	20 Locations	Sample if VOCs exceed health risk-based criteria in Phase I.	VOCs	40 + 8 QCs 48 Total

5.4.4.5.9 Schedule

See Annex I.

5.4.4.6 High-Volume Air Sampling at MDA G

5.4.4.6.1 Sampling and Analysis Components

The purpose of collecting and analyzing high-volume air samples at MDA G is to acquire technically accurate and legally defensible data. The data will be used to determine the extent of atmospheric transport of contaminants from MDA G and to quantify the range of pollution concentration over the sampling period. Data will be collected in accordance with EPA-accepted sampling and analysis procedures and the guidelines specified in this document. The data will be validated according to the functional guidelines for organic analysis (EPA 1988, 0293) and inorganic analysis (EPA 1988, 0296). Validation is necessary so that the data will be of such quality that they can be used in risk assessment calculations. Currently, there are no published EPA methods for validating all radionuclide analyses.

5.4.4.6.2 Sampling and Analysis Approach

This SAP is designed to determine the extent to which contaminants at MDA G impact air quality in the surrounding area. Because the sources of air contamination are all at ground level, worst-case (off-site) air pollution problems can be expected to occur at the fence line. The proposed sampling plan will provide an indication of baseline air quality in the immediate vicinity of MDA G. Data derived from this study will provide an indication of the extent of the air pollution problems caused by the release into the air of materials stored on site. In addition, these data will be used to determine whether the severity of the air quality impact warrants Phase II sampling. Further, these data will be used as inputs into risk assessment.

Because the pits and shafts at MDA G are extremely close together, a sampling system has been established to determine an overall off-site impact. The meteorological parameter of greatest importance in choosing air sampling locations for MDA G is the predominant wind direction relative to the site. Wind direction and speeds at MDA G are discussed in Section 3.1.4.1.

5.4.4.6.3 Primary Data Quality Factors

5.4.4.6.3.1 Prioritized Data Uses

The data to be collected are necessary for site characterization and risk assessment. Collected data will be used to establish whether any airborne contaminants from MDA G are being transported off site. The data will also be used to determine the potential impact of windborne contaminants on human populations or agricultural activities, and whether this impact warrants Phase II sampling.

5.4.4.6.3.2 Appropriate Analytical Levels

Samples collected will be screened in the field and analyzed in a laboratory using EPA SW-846 (third edition) protocol. Alpha, beta, and gamma survey instruments will be used in the field to screen the samples before they are shipped to the SCF. The levels of analysis are:

Level I Field Screen: Alpha, beta, gamma survey instruments,

Level III SW-846 Laboratory Methods, and

Level V Radionuclide Analysis Laboratory Methods.

5.4.4.6.3.3 Primary Contaminants of Concern

The contaminants of concern for this sampling activity at MDA G are SVOCs, metals, pesticides, PCBs, ROCs, and total suspended particulates (TSPs). ROCs at OU 1148 are listed in Table 5.4-18.

5.4.4.6.3.4 Levels of Concern

Appendix F of the IWP (LANL 1991, 0553) and 40 CFR 264, Proposed Subpart S, contain information on constituent levels of concern. Health risk-based determinations of levels of concern will be developed for constituents not listed in Appendix F. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 IWP. This approach will be developed in adequate time for data analysis.

5.4.4.6.3.5 Required Quantitation Limits

Quantitation limits for all parameters are presented in Tables V.3 through V.9 of the Laboratory's Generic QAPjP (LANL 1991, 0412).

5.4.4.6.3.6 Critical Samples

Samples collected at the following locations are critical to the objectives of this study: 1) directly downwind of the most contaminated areas of MDA G, 2) in the direction of Pajarito Road, a major traffic corridor that flanks the south side of OU 1148, 3) in the direction of White Rock, and 4) in the direction of Los Alamos. The first two locations will provide information regarding the magnitude of the air quality impact of airborne contaminants that may be transported off site, and the latter two will provide a measure of contaminants that may impact the nearest human populations.

5.4.4.6.4 Rationale for Sampling Activity

High-volume air samples will be collected at eight locations in MDA G (Figure 5.4-16). The justification for each sampling location is provided in Table 5.4-31.

The rationale for high-volume air sampling from the eight locations at MDA G is to:

- collect air quality data at the boundary of MDA G to determine if SVOCs, metals, pesticides, PCBs, ROCs, and TSPs are being transported off site; and
- collect data that can be used in a risk assessment.

5.4.4.6.5 Sampling Activity

A GPS-1 high-volume sampler will be used to collect air samples for analysis of SVOCs, metals, pesticides, PCBs, and radionuclides. Air samples for analysis of TSPs will be collected with a high-volume particulate air sampler. No analysis of samples will be conducted in the field. Samples will be collected once a month for a three-day period (72 hours). Samples will be collected each month for one year (8 samples x 12 months = 96 samples). The number of samples, the number of QC samples, and types of QC samples is given in Table 5.4-32. Sample collection procedures are presented in Section 7.0 of Appendix B.

5.4.4.6.6 Remaining SAP Elements

The remaining required elements of this SAP are common to all of the SAPs prepared for OU 1148. These common elements are listed in Table 5.4-20 and are located in Appendix B of this RFI Work Plan.

5.4.4.6.7 Phase II SAPs

If the results of Phase I sampling indicate that COCs exceed health risk-based criteria, then Phase II sampling will be conducted at MDA G. Instead of repeat high-volume air sampling, nine soil samples will be collected near the active storage sites to determine if they are the source of contaminants. Table 5.4-33 summarizes the Phase II sampling activities.

5.4.4.6.8 Health and Safety

This SAP will follow the procedures outlined in the Laboratory's Environment, Safety and Health Manual (LANL 1990, 0335) and Annex III of this RFI Work Plan.

5.4.4.6.9 Schedule

See Annex I.

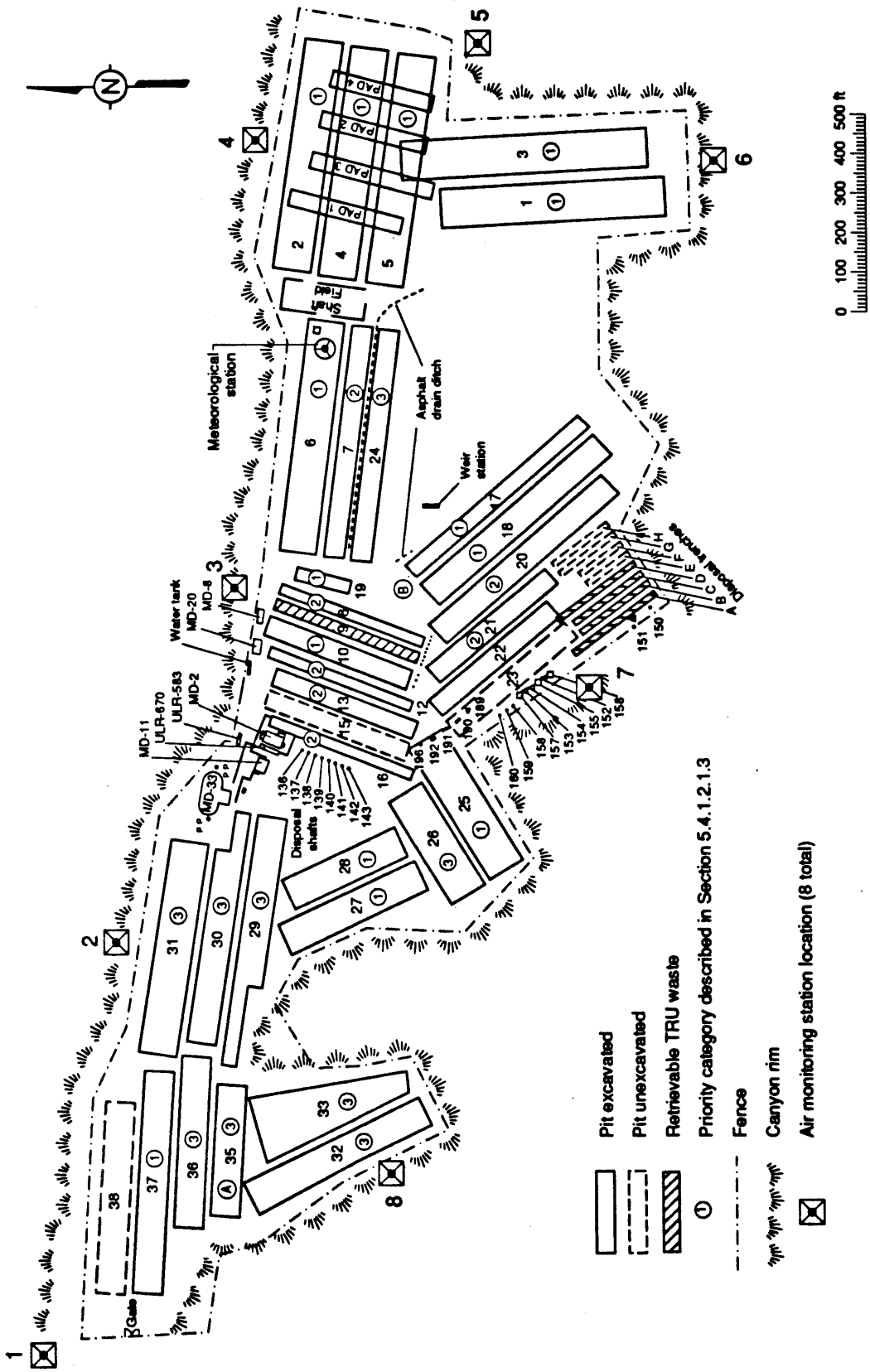


Figure 5.4-16 Location map of high-volume air sampling stations at MDA G.

TABLE 5.4-31
JUSTIFICATION FOR DETERMINING SAMPLING LOCATIONS AT MDA G

Monitor No.	Justification
1	In line with MDA G and town of Los Alamos
2	Based upon predominant south-southwesterly winds and location of active asbestos pits in northwest section of MDA G
3	Based upon predominant south-southwesterly winds and location of medium- and high-priority pits in the midsection of MDA G
4	Based upon predominant south-southwesterly winds and location of high-priority pits and TRU removal activity in the northeast section of MDA G
5	In line with MDA G and town of White Rock
6	Southeast corner of MDA G above Pajarito Road
7	South-central part of MDA G above Pajarito Road
8	Southwest corner of MDA G above Pajarito Road

TABLE 5.4-32
PHASE I SAMPLING AND ANALYSIS PLAN TABLE FOR HIGH-VOLUME AIR SAMPLING AT MDA G

Media	# of Samples	# of QC[a] Samples	Total Samples	Analysis
Air (PUF/XAD Filters and Cartridges)	96	24	120	SVOCs Metals PCBs Pesticides ROCs[b]
Air (Glass-Fiber Paper Filters)	96	24	120	Total Suspended Particulates

[a]Includes: Duplicate Sample and Equipment Blank.

Duplicate Sample: Collect two separate samples simultaneously from the same location.

Equipment Blank: A GPS-1 high-volume sampler PUF/XAD filter and cartridge and a high-volume particulate sampler glass-fiber paper filter will be transported to the field during each sampling event and then shipped back to the Sample Coordination Facility with the field samples.

[b]Radionuclides of Concern for (ROCs) OU 1148 (see Table 5.4-18).

TABLE 5.4-33
PHASE II HIGH-VOLUME AIR (SOIL) SAMPLING AT MDA G

Media	Phase Sampling	Rationale	Analysis	# of Samples
Soil	9 locations	Sample if COCs exceed health risk-based criteria during Phase I.	COCs	9 + 4 QCs 13 Total

5.4.4.7 Tritium Air and Soil Sampling at MDA G

Tritium (^3H, or T) is produced naturally in the upper atmosphere by cosmic irradiation, and as a fission or neutron activation product in nuclear reactors. Tritium can exist in the gas phase as HT or T_2; however, tritium oxidation and exchange reactions with H_2O produce tritiated water, HTO, the most common form of environmental tritium (NCRP 1979, 0739). Uptake of inhaled or ingested HTO is rapid and 99% efficient (NCRP 1979, 0739). Although inhalation exposure of people to HT gas might occur, uptake is inefficient and only 0.004% of the inhaled HT is absorbed after oxidation to HTO. Thus, it would require approximately 25,000 ppm of HT in air to pose the same hazard as 1 ppm HTO. Therefore, this SAP is directed toward detection of tritiated water vapor.

5.4.4.7.1 Sampling and Analysis Components

The purpose of collecting air and soil samples for tritium analysis at MDA G is to accumulate technically accurate and legally defensible data. This SAP is designed to obtain information on tritium air and soil concentrations and transport in the environment around MDA G that is necessary to support the DQO decisions.

Phase I of this SAP will use a biased sampling approach directed toward sites known to contain high levels of tritium or where tritium releases have been reported. Interpretation of these Phase I data will be compared with tritium sampling data collected by the EM-8 Environmental Surveillance Program (LANL 1990, xxxx) and data reported in historic summaries (Rogers 1977, 0216). Further, the Phase I data will be used to determine the required quality of data needed in the Phase II effort to support the DQO decisions.

5.4.4.7.2 Sampling and Analysis Approach

Because environmental tritium occurs as tritiated water, tritium sampling methods have been developed to isolate and analyze moisture, often in vapor form (NCRP 1976, 0738). Airborne tritiated water vapor is absorbed by a desiccant, isolated by distillation, and measured by liquid scintillation counting. Tritiated water associated with soil samples is similarly analyzed by distillation and liquid scintillation counting.

5.4.4.7.3 Primary Data Quality Factors

The primary factors required to ensure that appropriate data are collected include the intended use of the data, the appropriate level of analytical effort to support the intended use, the primary contaminant of concern, and its associated level of concern. Further, it must be shown that the analytical methods used are able to detect the contaminant at concentrations low enough to determine whether significant contamination of environmental media exists.

5.4.4.7.3.1 Prioritized Data Uses

The data to be collected are necessary for site characterization and risk assessment.

- Site Characterization - Historic summaries of activities at MDA G (Rogers 1977, 0216), and ongoing environmental surveillance activities elsewhere at the Laboratory (Environmental Protection Group 1990, 0497; and previous reports) have reported tritium sampling data. The historic studies were directed toward determining the behavior of tritium in tuff and provided information on the extent of contamination around existing pits and shafts at MDA G. However, more measurements are needed to confirm the current spatial distribution of tritium in soils around pits and shafts. Although off-site measurements of airborne tritium are made as part of the Environmental Surveillance Program, measurements within MDA G have not been made. Samples will be taken within the MDA G boundary during Phase I of this SAP.

- Risk Assessment - Source term data for tritium are needed to determine the surface emanation rate of tritium for unit risk calculations and to provide source term data for flow and transport modeling using TRACR3D.

5.4.4.7.3.2 Appropriate Analytical Levels

The sampling and analysis methods described in Section 5.0 of Appendix B correspond to Level V analytical methods and will be used throughout this SAP. Because these tritium measurements correspond to Level V, the Phase I sampling and analysis effort will be directed toward determining the locations of greatest contamination, and providing concentration and emanation data as needed to support risk assessments.

5.4.4.7.3.3 Primary Contaminant of Concern

Tritium in the form of tritiated water vapor is the contaminant of primary concern for this sampling activity at MDA G.

5.4.4.7.3.4 Levels of Concern

The DOE Derived Concentration Guide (DCG) for tritium in air in uncontrolled areas is 1×10^{-7} µCi/ml in air; for tritium in water, the DCG is 2×10^{-3} µCi/ml (Environmental Protection Group 1990, 0479). DOE Order 5280.2A requires that the radiation exposure of the general public from waste disposal activities will not exceed 100 mrem/yr.

5.4.4.7.3.5 Required Quantitation Limit

The quantitation limit concentrations for tritium in the respective matrices are (Environmental Protection Group 1990, 0479):

Air: $1x10^{-4}$ pCi/m^3 (given as $1x10^{-10}$ µCi/m^3 in Environmental Protection Group 1990, 0479)

Soil: $3x10^{-3}$ pCi/g

These quantitation limit concentrations can be used to estimate the annual dose to an individual by using the dose conversion factor of 0.095 µrad/pCi yr/L_{H2O} (NCRP 1979, 0739). Because there is no dose conversion factor given for food intake, the tritium concentration in food was assumed to equal the concentration in water. The HTO content of air was calculated from the average absolute humidity at MDA G of 4.8 ± 1.9 gH_2O/m^3 air (Bowen 1990, 0033). The annual does corresponding to these quantitation limit concentrations is 60 rem, which is 0.06% of the 100 mrem/yr equivalent dose limit specified in DOE Order 5820.2A. The annual dose from exposure to air at the quantitation limit concentration of $1x10^{-4}$ pCi/m^3 is $1.5x10^{-7}$ mrem, or approximately $1.5x10^{-6}$% of the 10 mrem annual dose limit (Environmental Protection Group 1990, 0479).

5.4.4.7.3.6 Critical Samples

The tritium samples most critical to site characterization and risk assessment include:

- Airborne Tritium Samples - collected as HTO vapor, and
- Soil Tritium Samples - collected from within 0-5 cm of the surface.

5.4.4.7.4 Rationale for Sampling Activity

Samples of airborne and soil tritium as tritiated water vapor will be critical to site characterization and to the development of tritium vapor transport models to support risk assessment activities.

An important feature of this tritium sampling and analysis plan is the use of data from surface soil and air samples to provide the surface emanation rates required to describe the source term for transport models and risk assessments. A further use will be to correlate the concentrations of HTO in the soils and the amount of HTO released to the air by evapotranspiration, and to investigate whether the correlation is sufficiently strong to allow the use of surface soil as a marker for the extent and concentration of a potential underground tritium plume. If a strong correlation can be shown, routine measurements of surface soil would allow a subsurface concentration to be estimated above disposal pits where drilling might not be safe. Similarly, the soil and air data could be used to locate new sampling wells efficiently.

5.4.4.7.5 Sampling Activity

Air tritium samples will be collected with silica gel columns as described in Section 5.0 of Appendix B. A minimum of 3 m^3 of air will be collected for each air tritium

sample. This volume represents approximately the volume required to allow the detection limit concentration of $1x10^{-10}$ $\mu Ci/m^3$ (Environmental Protection Group 1990, 0479, Table C-26). Eight samples will be collected over a 17-day period each month for one year from the locations shown on Figure 5.4-17. A total of 96 environmental air tritium samples will be collected (8 samples x 12 months = 96 total samples).

Soil tritium samples will be collected according to the procedures in Section 5.0 of Appendix B. A minimum of 1 kg of soil will be collected for each soil tritium sample. This mass represents the mass required to allow the detection limit concentration of 0.003 pCi/g (Environmental Protection Group 1990, 0479, Table C-26). One set of 162 samples will be collected from the locations shown on Figures 5.4-18 through 5.4-21.

Table 5.4-34 lists the number of samples, the number of QC samples, and the analytical requirements for the Phase I investigation. It also describes the types of QC samples required.

No tritium screening will be done in the field. Routine scanning in the field for alpha and beta/gamma emitters will be done as a preliminary indicator of radiological contamination. Field instruments, such as the "Violinist," which is available from HS-12, can be used to detect alpha emitters by detecting the related gamma emissions. This instrument is an upgrade of the "Fidler" instrument.

5.4.4.7.6 Remaining SAP Elements

The remaining required elements of this SAP are common to all of the SAPs prepared for OU 1148. These common elements are listed in Table 5.4-20 and are presented in Appendix B of this RFI Work Plan.

5.4.4.7.7 Phase II SAP

If tritium air or soil concentrations exceed health risk-based criteria during the Phase I investigation, then vegetation samples will be collected for tritium analysis at MDA G. These samples will be collected from three locations that had the highest tritium concentrations during Phase I sampling. Table 5.4-35 summarizes the Phase II sampling plan for MDA G.

5.4.4.7.8 Health and Safety

This SAP will follow the procedures outlined in the Laboratory's Environment, Safety and Health Manual (LANL 1990, 0335) and in Annex III of this RFI Work Plan.

5.4.4.7.9 Schedule

See Annex I.

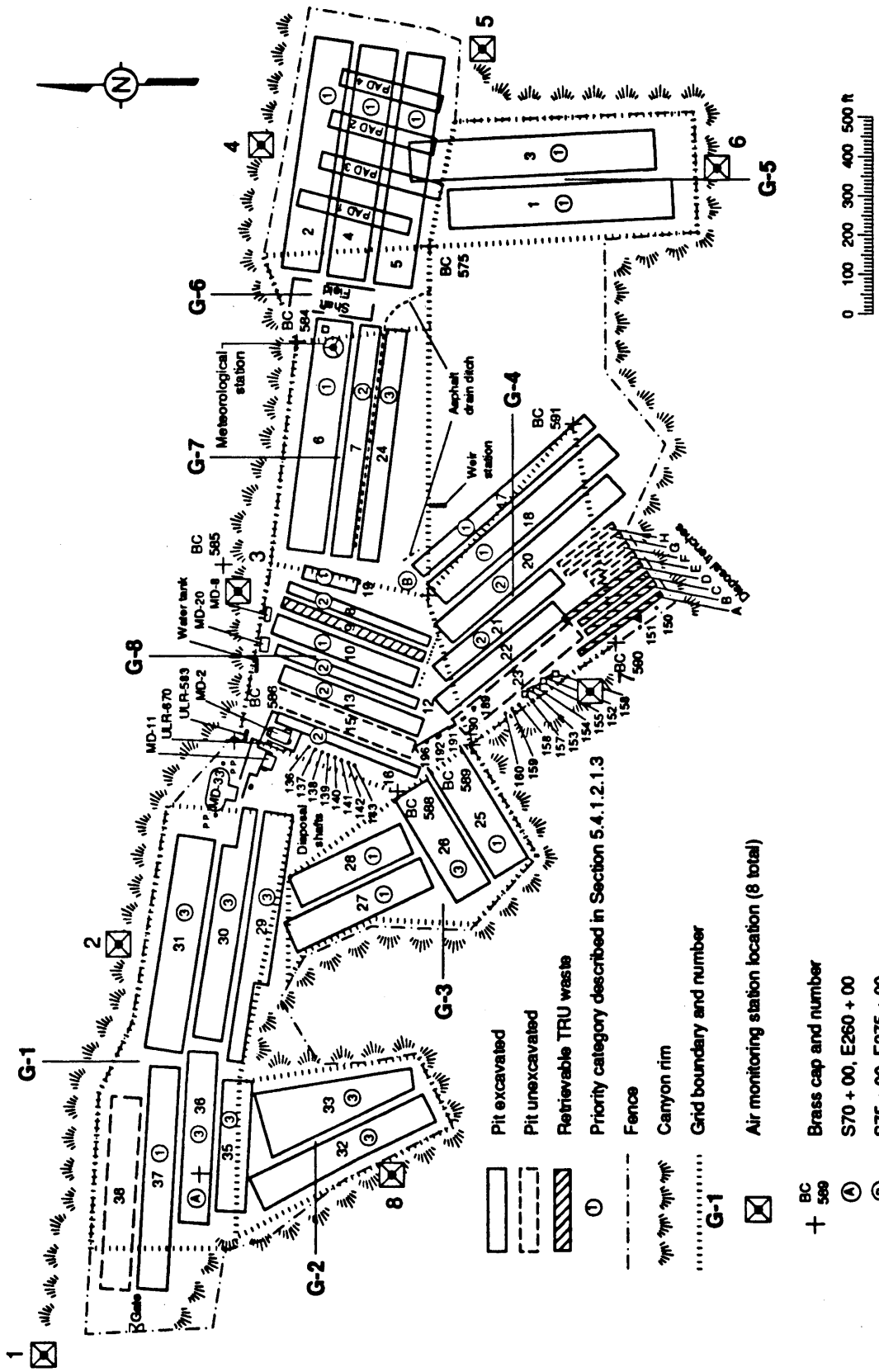


Figure 5.4-17 Location map of tritium air sampling locations and grid boundaries for tritium soil sampling at MDA G.

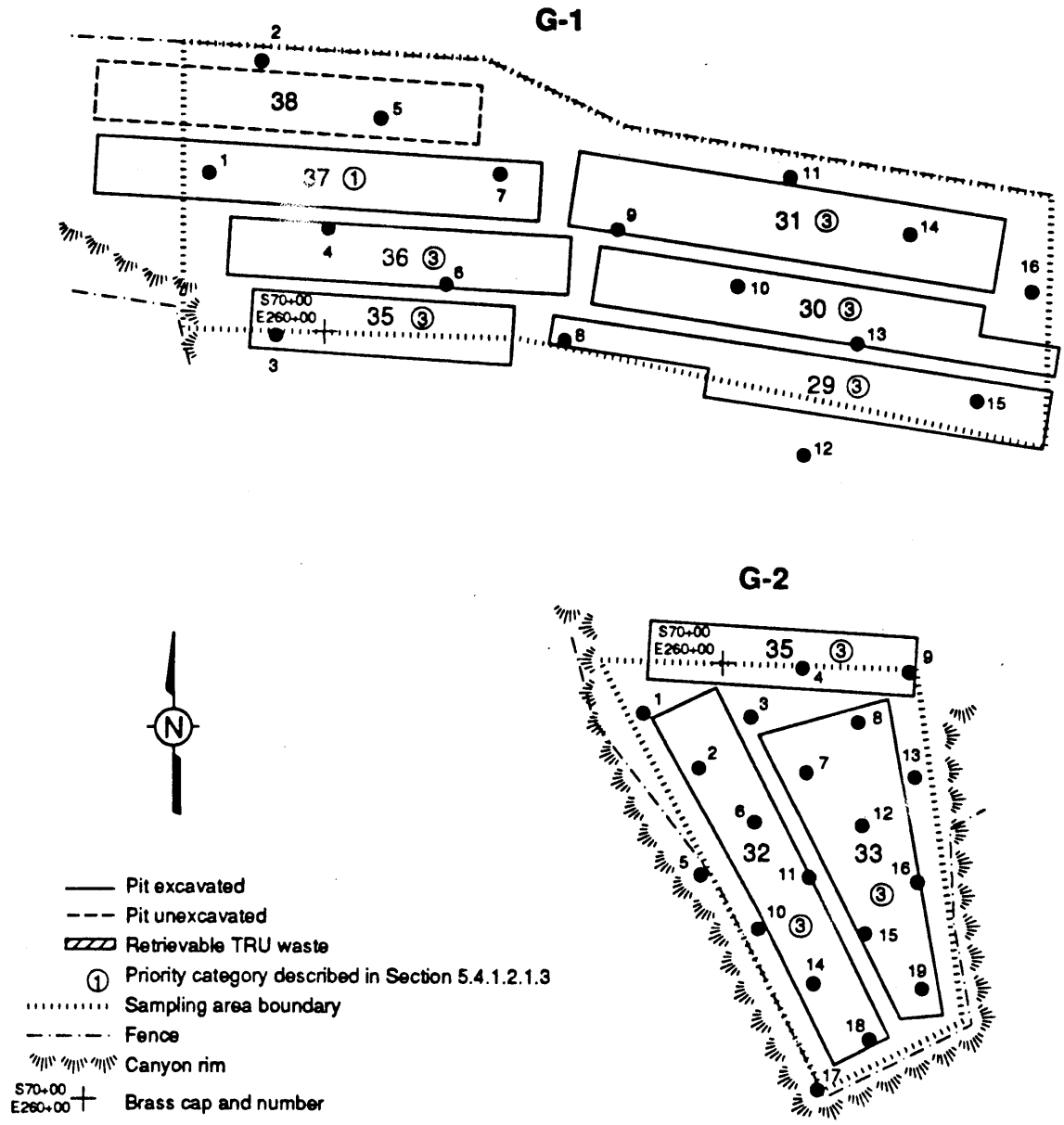


Figure 5.4-18 Location map of tritium soil samples in grids G-1 and G-2 at MDA G.

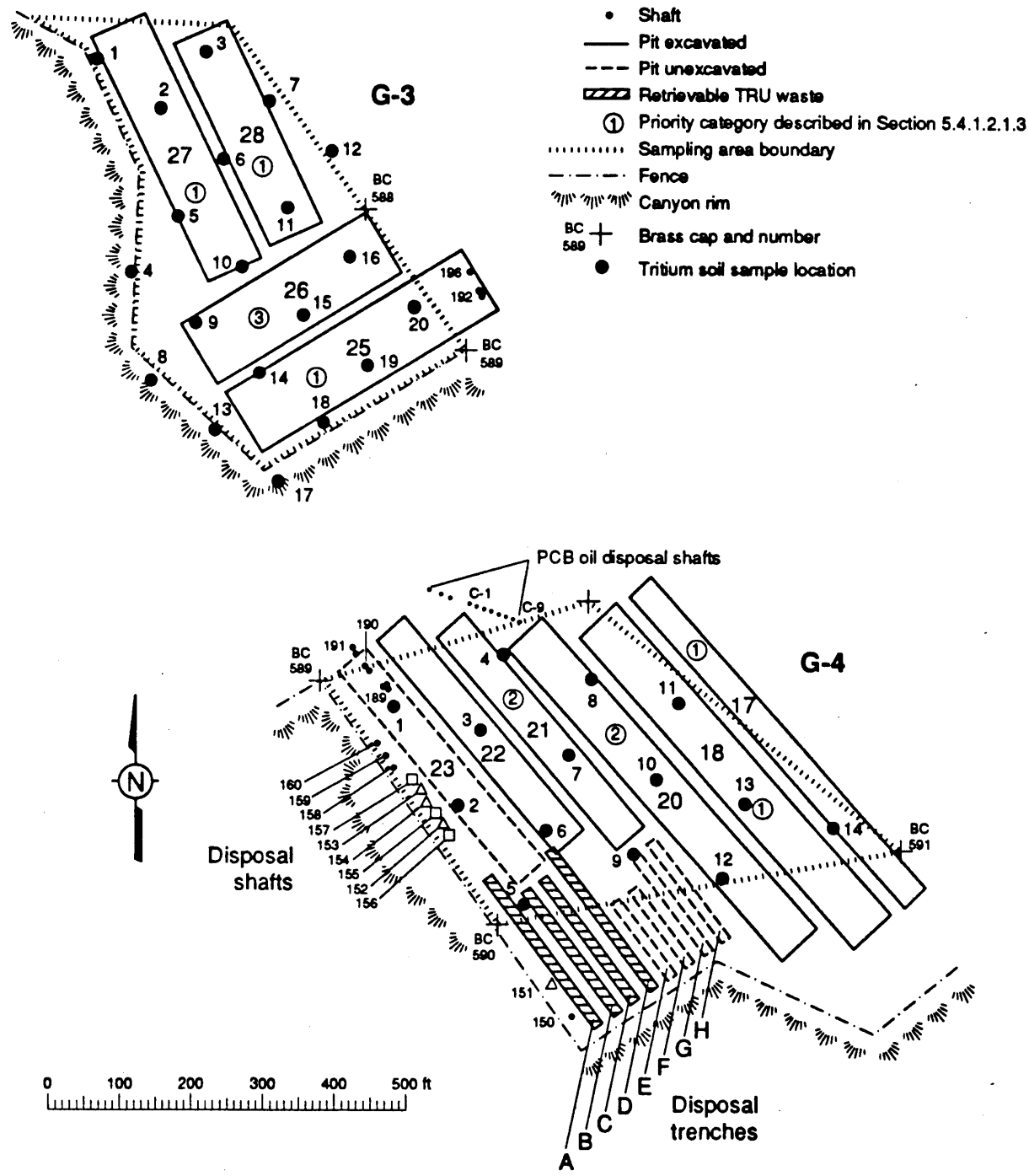


Figure 5.4-19 Location map of tritium soil samples in grids G-3 and G-4 at MDA G.

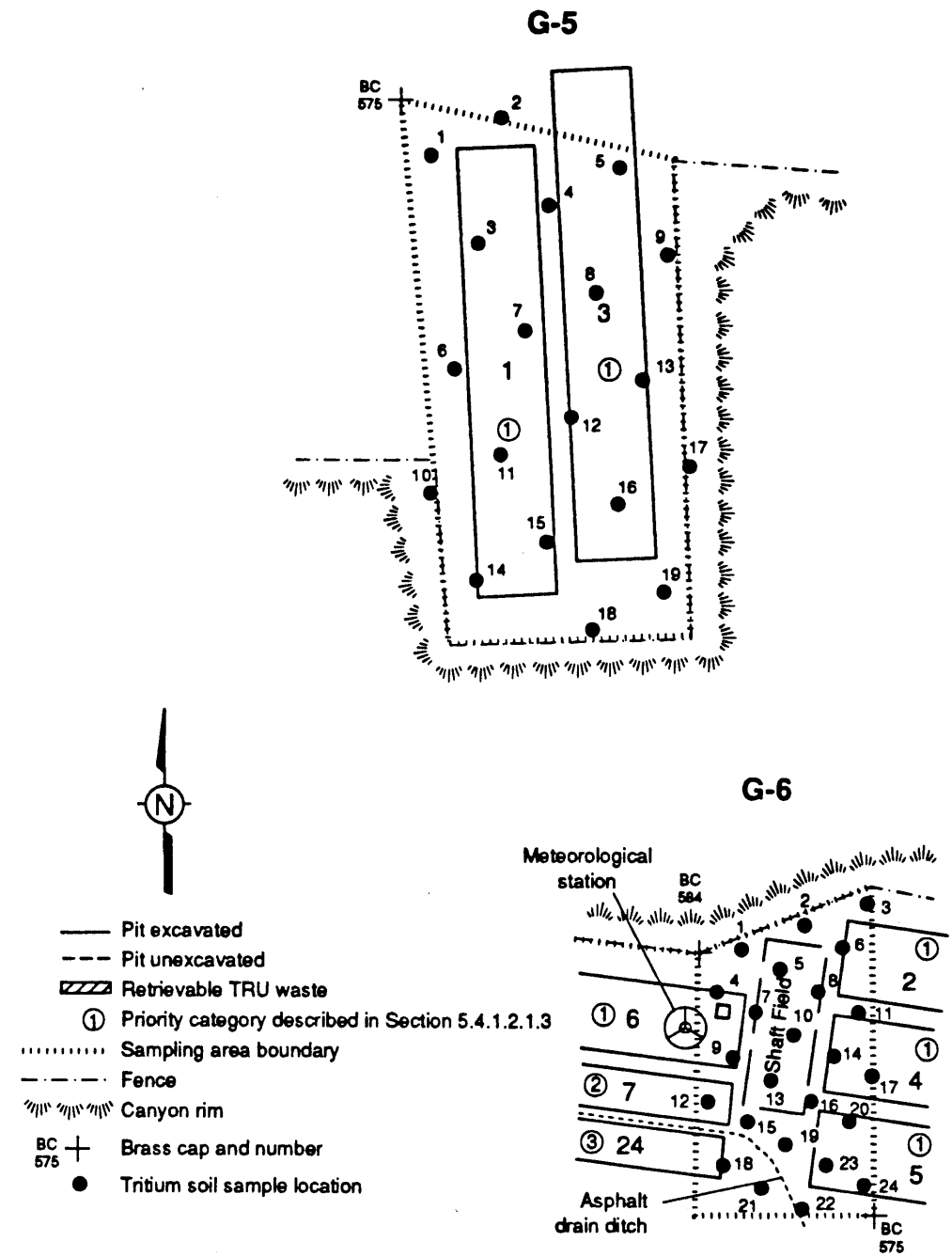


Figure 5.4-20 Location map of tritium soil samples in grids G-5 and G-6 at MDA G.

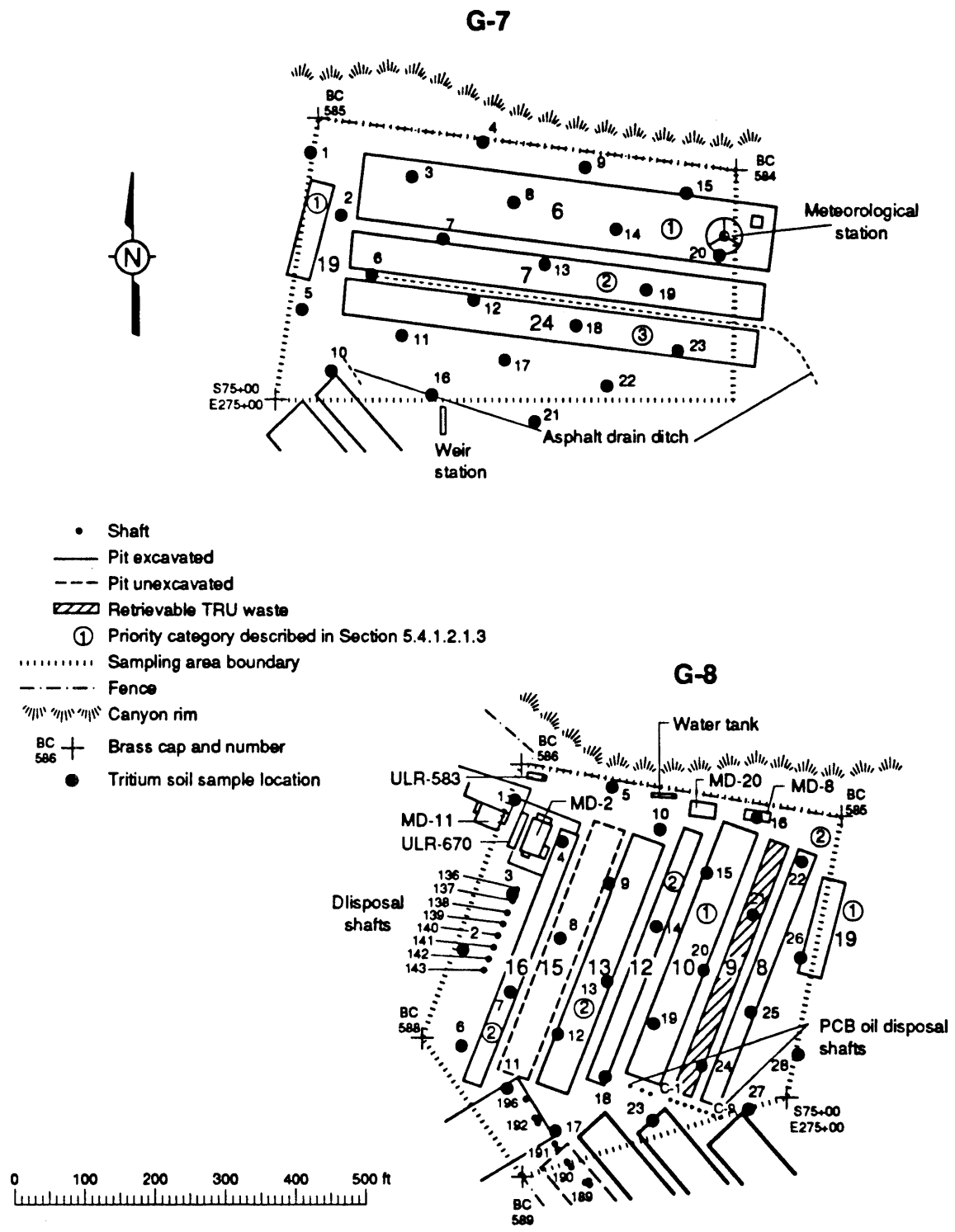


Figure 5.4-21 Location map of tritium soil samples in grids G-7 and G-8 at MDA G.

TABLE 5.4-34
PHASE I SAMPLING AND ANALYSIS PLAN TABLE FOR TRITIUM AIR AND SOIL SAMPLING AT MDA G

Media	# of Samples	# of QC[a] Samples	Total Samples	Analysis
Soil	162	18	180	Tritium
Air (Silica Gel)	96	10	106	Tritium

[a]Includes Field Blank (for air samples), Duplicate Samples, and Equipment (Rinsate) Blank (for soil samples).

Field Blank (Air): Collect the sample by exposing a silica gel column for a 17-day period. Select a site far enough away from the contaminated area to assess field conditions at the sampling site.

Duplicate Sample (Air): Fill two silica gel columns simultaneously from the same sampling area.

Duplicate Sample (Soil): Split a soil sample into two duplicate samples. Fill the sample containers simultaneously from the same sampling area.

Equipment (Rinsate) Blank (Soil): Pour organic-free water over clean, decontaminated sampling equipment. Pour the water over the equipment surface that comes in contact with the sample. Collect the rinsate in a sample container and treat the equipment blank as a water sample.

TABLE 5.4-35
PHASE II TRITIUM AIR AND SOIL (VEGETATION) SAMPLING AT MDA G

Media	Phase II Sampling	Rationale	Analysis	# of Samples
Vegetation	3 locations	Sample if tritium exceeded health risk-based criteria during Phase I.	Tritium	3 + 2 QCs 5 Total

5.5 Septic Tank SWMU Aggregate TA-51/TA-54 (Western Part)

5.5.1 Background

5.5.1.1 Description and History

TA-51

TA-51 is currently the base of operations for the Experimental Engineering Test Facility (EETF), which supports research to develop effective isolation techniques for the burial of wastes in semiarid climates. The EETF was built in 1980, and support offices for staff were constructed in 1986.

TA-54

A Radiation Exposure Facility located in the western part of TA-54 was in operation from 1962 to the mid-1970s. The facility was used for biomedical research on the exposure of animals to radiation. The radiation sources were removed from the facility when research was terminated. Currently, the facility is used for research on the exposure of animals to the oxides of nitrogen. An Animal Holding Facility was constructed in the mid-1960s in what is now the western part of TA-54. The facility housed animals used by the Laboratory's biomedical research program until the late 1980s. Currently, this facility is being remodeled as an analytical laboratory for environmental samples.

The NDT Facility was built for the purpose of performing final verification testing and certification of radioactive transuranic (TRU) waste that will be transported to the Waste Isolation Pilot Plant (WIPP). Certification procedures include the use of nondestructive testing techniques such as real-time radiography, passive-active neutron assay, and ultrasonics. The operations will verify the physical composition of the waste inside the package; verify the specific identity and quantity of radioactive contaminants; and provide for the certification of waste requiring no further processing and meeting WIPP waste acceptance criteria (LANL 1991, 08-0024). Although TA-54 West was opened in 1990, operations have been discontinued until safety assessment requirements have been met (LANL 1991, 08-0024).

5.5.1.2 Conceptual Exposure Model

5.5.1.2.1 Existing Information on the Nature and Extent of Contamination

TA-51

The three SWMUs in TA-51 include an active septic system and two multiple-celled caissons that are used for research studies on the design of covers to protect and isolate waste burial sites. The active septic system (SWMU 51-001) is not expected to be contaminated with radioactive or hazardous substances; however, the septic

system will be investigated for contamination after it is removed from service by the Laboratory in 1992 or 1993. The two multiple-celled caissons [SWMU 51-002(a,b)] and an area of concern (C-51-001, a storage area for clean soil at TA-51-38) are recommended for NFA; they are discussed in Section 6.5.

A brief description of the three SWMUs in TA-51 is given in Table 5.5-1.

Active Septic System

The location of the active septic system (SWMU 51-001) that provides service to the offices of the EETF is shown on Figure 5.5-1. Structures comprising this SWMU include TA-51-03, a 1,000-gal septic tank, and TA-51-31, a seepage pit. The construction detail for the seepage pit is shown on Figure 5.5-2. The seepage pit is 4 ft in diameter and 50 ft deep. The septic tank is connected to the seepage pit by a 4-in-diameter vitrified clay pipe buried in a 2-ft, 6-in-deep trench. The vitrified clay pipe connects to a 4-in-diameter perforated PVC drop pipe that extends to within 2 ft of the bottom of the pit. The pit is backfilled with screened gravel. The NMED registration number for the septic system is LA-53. The system was installed in 1983 to serve the Environmental Research Lab (Structure TA-51-11) and the Environmental Science Lab (Structure TA-51-12). Transportable offices for the Laboratory's Health Physics Policy and Programs Group (HS-12) (Structures TA-51-25, -26, and -27) were connected to the septic system when they were placed at TA-51 in 1986.

The septic system has received only sanitary waste. There is no indication that radioactive or hazardous waste was discharged to the system. Contaminants are not expected to have been released to the environment. Sampling to confirm the absence of contamination will be done after the facilities at TA-51 are connected to a sanitary line installed by the Laboratory's Sanitary Wastewater Systems Consolidation (SWSC) Program. The sanitary line is scheduled to be in operation in 1992 or 1993.

TA-54

The Solid Waste Management Units Report identifies six SWMUs in the western part of TA-54 (LANL 1990, 0145). These SWMUs include three active septic systems, a truck washing pit, a TRU waste staging area, and a sump. The Laboratory has scheduled the septic systems to be removed from service in 1992 or 1993. At that time, the septic systems will be investigated for contamination. The truck washing pit, the staging area, and the sump have been recommended for NFA. In addition, an AOC (C-51-002), which consists of the former locations of two explosives magazines, is also recommended for NFA. The SWMUs and AOC recommended for NFA are discussed in Section 6.6. A brief description of the SWMUs and AOC in TA-54 West is given in Table 5.5-2.

Active Septic Systems

The location of the active septic system [SWMU 54-007(c)] that provides service to the TA-54-34 office building and the TA-54-38 NDT Facility is shown on Figure 5.5-3. Structures comprising this SWMU include a 2,000-gal septic tank and a seepage trench constructed with 4-in-diameter drain tile. This seepage trench also receives

TABLE 5.5-1
DESCRIPTION OF SWMUs AND AREAS OF CONCERN (AOCs) IN TA-51

SWMU or AOC No.	SWMU or AOC Description	Status for Investigation
51-001	Active septic system for offices that support the EETF	Phase I Sampling and Analysis Plan
51-002(a)	Environmental Research Site Caisson TA-51-38	No Further Action (NFA); see Section 6.5
51-002(b)	Environmental Research Site Caisson TA-51-39	NFA; see Section 6.5
C-51-001	Drummed, clean soil stored at TA-51-38	NFA; see Section 6.5

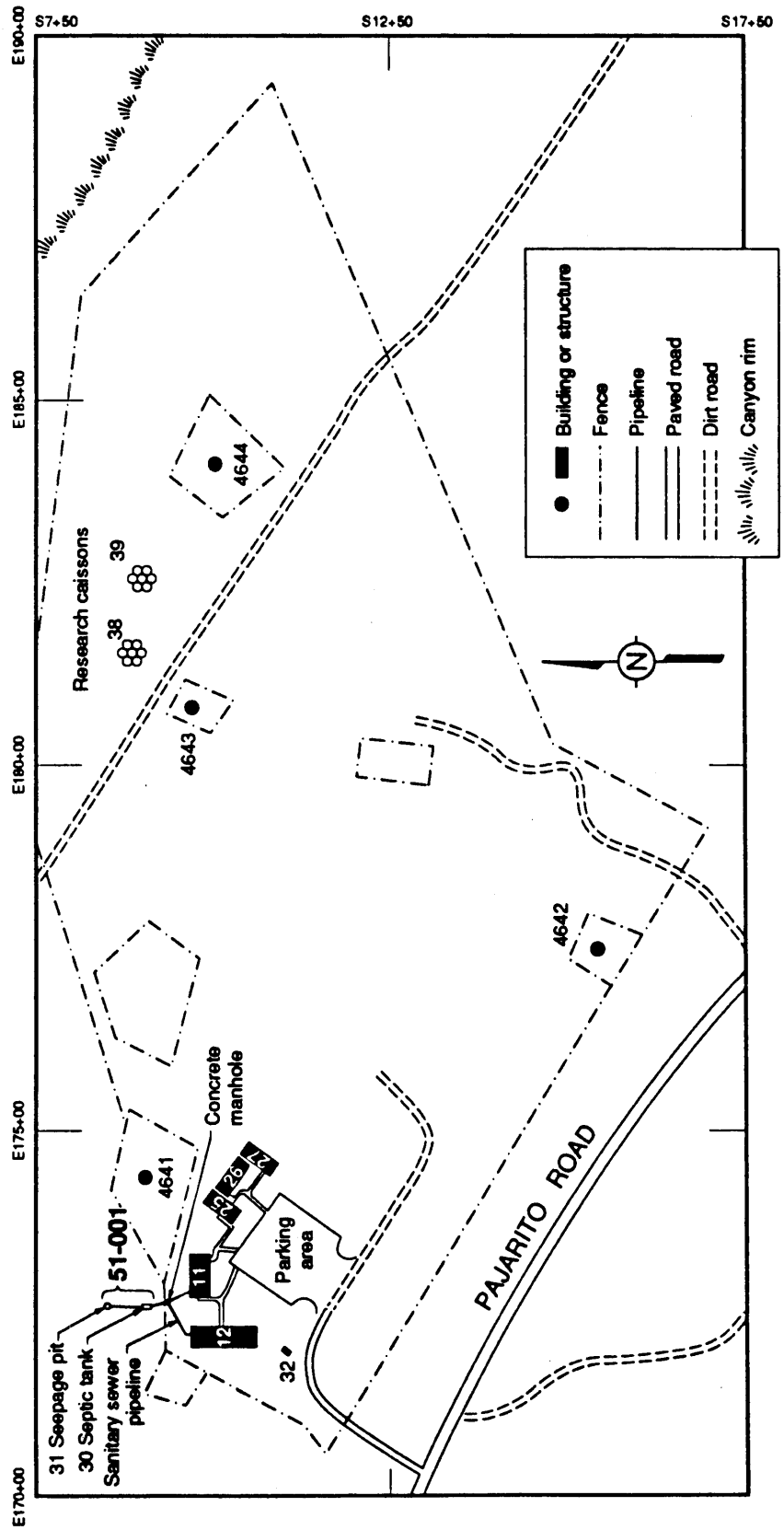


Figure 5.5-1 Location map of TA-51, SWMU 51-001 (LANL 1983 [ENG C44263]; LANL 1984 [ENG R45128]; LANL 1985 [ENG C44821]; LANL 1990 [0145]).

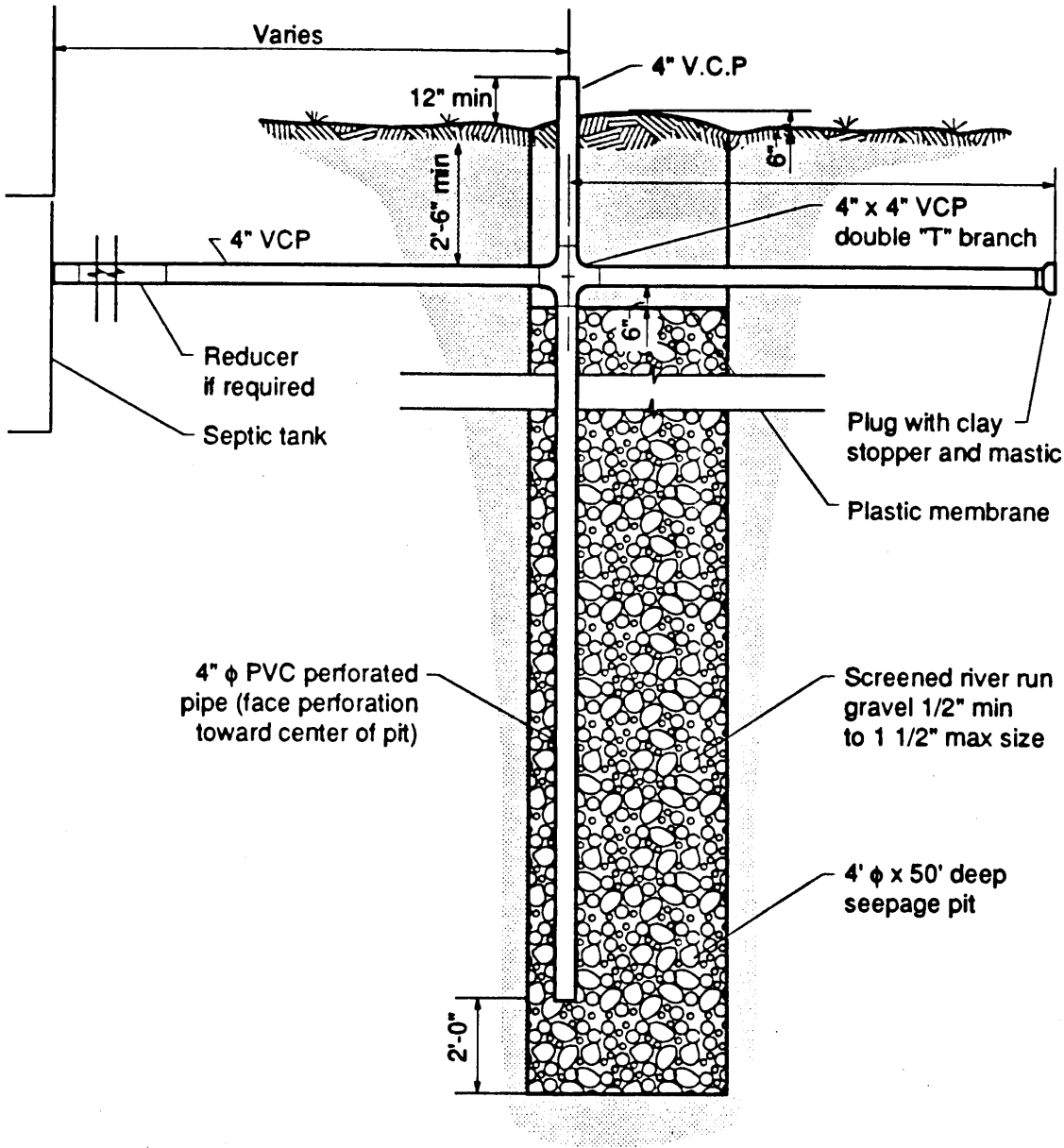


Figure 5.5-2 Seepage pit construction detail for TA-51-31 (LANL 1983 [ENG C44263]).

TABLE 5.5-2
DESCRIPTION OF SWMUs AND AREAS OF CONCERN (AOCs)
IN WESTERN PART OF TA-54

SWMU or AOC No.	SWMU or AOC Description	Status for Investigation
54-007(c)	Active septic system for an office building and the NDT facility	Phase I Sampling and Analysis Plan (SAP)
54-013(a)	Planned truck-washing pit that was never built	No Further Action (NFA); see Section 6.6
54-007(d)	Active septic system for the former Radiation Exposure Facility	Phase I SAP
54-007(e)	Active septic system for the former Animal Holding Facility	Phase I SAP
54-015(h)	A drum storage area in the NDT Facility	NFA; see Section 6.6
54-016(a)	A sump in the TRU-waste staging area that discharges to a canyon outfall	NFA; see Section 6.6
C-51-002	Former locations of two explosives magazines	NFA; see Section 6.6

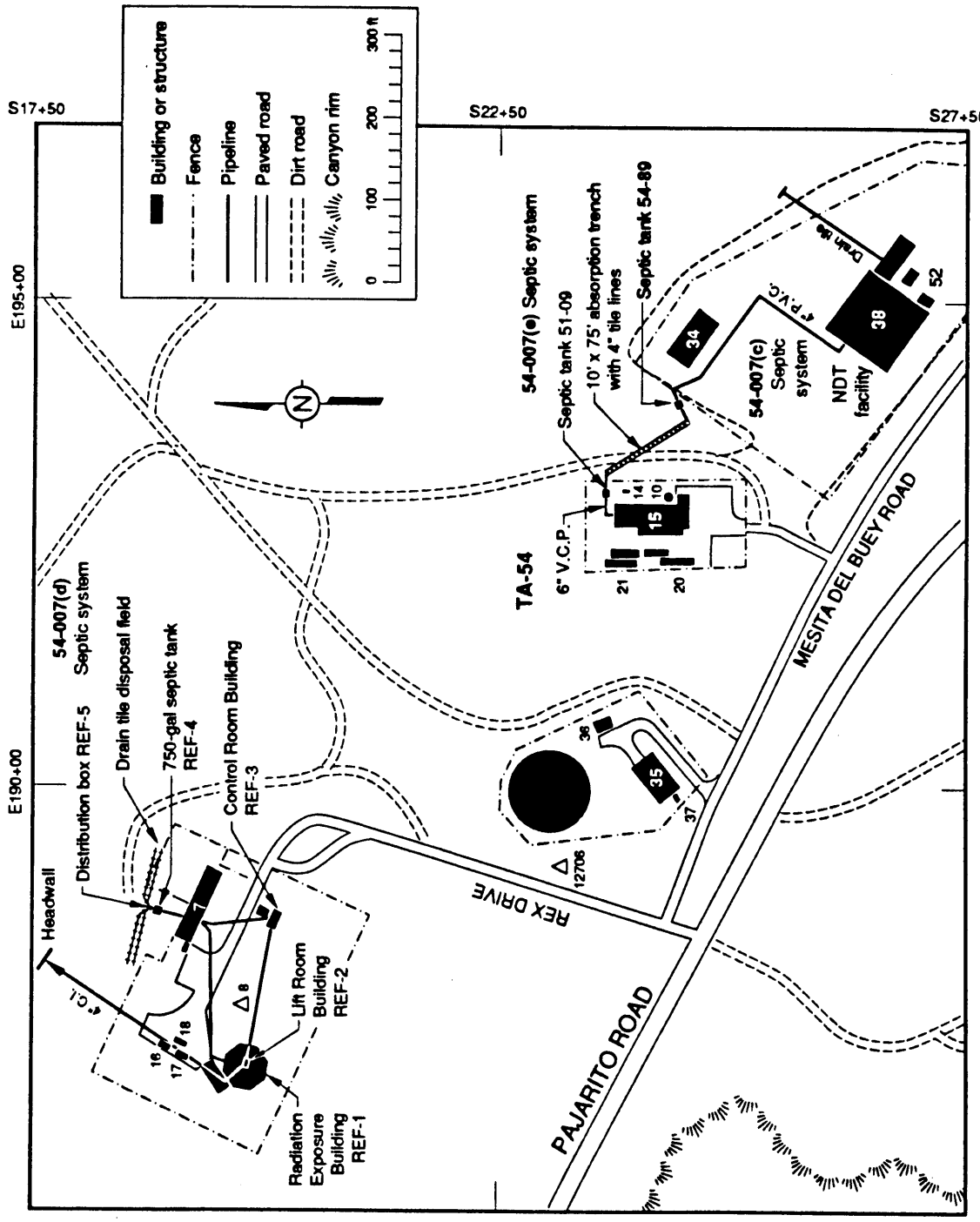


Figure 5.5-3 Location map of the western portion of TA-54, SWMUs 54-007(c, d, e). (LASL 1961 [ENG C-30337]; LASL 1977 [LA-RN-A-11]; LANL 1984 [ENG-R5128]; LANL 1985 [ENG 54-47]; LANL 1990 [0145])

sanitary waste (and in the past, animal waste) from the former Animal Holding Facility through the SWMU 54-007(e) septic system. The NMED registration number for SWMU 54-007(c) is SF 880 260. There is no indication that radioactive or hazardous wastes were disposed to the system. Sampling to confirm the absence or presence of contamination in the septic system will be performed after the facilities it serves are connected to a sanitary line to be installed by the Laboratory's SWSC Program. The sanitary line is scheduled to be in operation in 1992 or 1993.

The location of the active septic system [SWMU 54-007(d)] that provides service to the former Radiation Exposure Facility is shown on Figure 5.5-3. The septic system includes a 972-gal tank (TA-54-4) that is connected to a trench constructed with 4-in-diameter drain tile. The NMED registration number for the septic system is LA-51. The system was installed in 1962 at the time of the construction of the Radiation Exposure Facility. Structures at the facility that are connected to the septic system are the former Radiation Exposure Building (TA-54-1), the Lift Building (TA-54-2), the Control Building (TA-54-3), and the former Dog Holding Facility (TA-54-7).

The Radiation Exposure Facility conducted research on the exposure of animals to gamma radiation from cobalt-60 sources. The research was conducted from 1962 to the mid-1970s. The three cobalt-60 sources (10, 100, and 1,000 Ci) were removed when the radiation exposure research was completed. From the mid-1970s to the mid-1980s, structures at the former Radiation Exposure Facility were used to house animals including mice, dogs, sheep, miniature swine, and cows. These animals were used in biomedical research on exposure to fiberglass, oil-shale dust, and oil-shale retort gases. Animal wastes were routinely removed from the facility for disposal in a sanitary landfill. The Control Building (TA-54-3) is currently used for nitrogen dioxide and nitric oxide inhalation studies on small rodents. The other structures at the facility are presently inactive.

The septic system for the former Radiation Exposure Facility has received sanitary waste and animal waste. There is no indication that radioactive or hazardous waste was disposed to the septic system. Sampling to confirm the presence or absence of contamination will be done after the facilities in the western part of TA-54 are connected to a sanitary line to be installed by the Laboratory's SWSC Program. The sanitary line is scheduled to be in operation in 1992 or 1993.

The location of the septic system [SWMU 54-007(e)] that provides service to the former Animal Holding Facility is shown on Figure 5.5-3. Structures comprising this SWMU include a 1,500-gal septic tank (TA-54-9) that is connected to a seepage trench formed by two parallel buried lines of 4-in-diameter tile. The seepage trench is also connected to the septic tank in SWMU 54-007(c) that provides service to an office building and the NDT Facility. The NMED registration number for SWMU 54-007(e) is LA-52. The septic system was installed in the mid-1960s during construction of the Animal Holding Facility (TA-54-15). Animals were last held at the facility in 1987. Structure TA-54-15 is currently being remodeled for use by the Laboratory's Health and Safety (HS) Division in association with activities at TA-54 West. The septic system received sanitary waste and animal waste. There is no indication that radioactive or hazardous wastes were disposed to the system. Sampling to confirm the presence or absence of contamination will be performed after the facilities it serves are connected to a sanitary line to be installed by the

Laboratory's SWSC Program. The sanitary line is scheduled to be in operation in 1992 or 1993.

5.5.1.2.2 Potential Pathways of Contaminant Migration

The septic systems are not expected to have released contamination to the environment; however, sampling will be performed to confirm the absence of contamination.

The septic systems are designed to discharge fluids to the subsurface through a seepage pit or seepage trenches. Leakage may occur at joints where pipes connect to structures or at joints between sections of pipe. Introduction of liquid contaminants to a septic system would result in contamination of the surrounding soil and underlying tuff.

There are several potential migration pathways for transport of contaminants released to the subsurface from a septic system. Contaminants could be transported upward into soils at land surface by evapotranspiration and by the activities of burrowing animals. Volatile contaminants could migrate horizontally and vertically in the subsurface by vapor-phase transport. Excavation of a septic system site could expose contaminants. Over time, erosion could also expose contaminants. Exposure pathways include inhalation of contaminated dust and ingestion of contaminated soil or vegetation grown in contaminated soil in the immediate area of the septic systems.

Transport of contaminants off site by the surface water runoff pathway or air pathway is possible; however, due to the low level of potential contamination of the source area, dispersion processes in these pathways would not impact receptors. Therefore, contaminants released from the septic systems are not a concern for groundwater contamination in perched aquifers in the canyons or in the main aquifer deep below the mesa.

The migration pathways and receptors for potential contaminants released from the active septic systems are illustrated on Figure 5.5-4.

5.5.1.2.3 Potential Public Health and Environmental Impacts

Based on existing information, the active septic systems have not received radioactive or hazardous wastes. As a result, there are no known potential public health or environmental impacts.

5.5.2 Remediation Alternatives and Evaluation Criteria

The septic systems may be removed by a voluntary corrective action after the facilities using the systems are connected to a sanitary line installed by the Laboratory's SWSC Program. This simple removal action is subject to change if

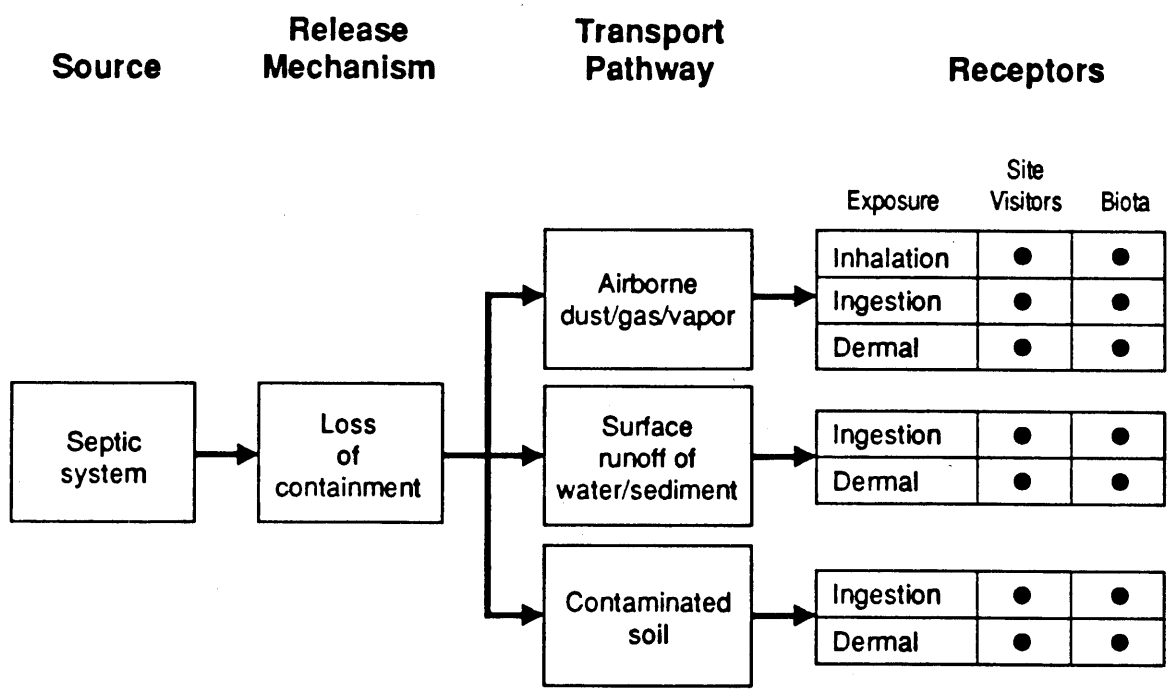


Figure 5.5-4 Conceptual model for septic systems in the TA-51/TA-54 SWMU Aggregate.

radioactive or hazardous wastes are identified in the septic systems or their discharge areas by Phase I sampling analyses.

5.5.3 Data Needs and Data Quality Objectives

5.5.3.1 Health and Safety Risks

5.5.3.1.1 Source Characterization

The active septic systems are not expected to be contaminated with radioactive or hazardous substances because they managed sanitary and animal wastes only. This expectation needs confirmation by sampling because the septic systems are fed by numerous drains that are not monitored. As a result, there is the possibility that small quantities of radioactive or hazardous wastes have been disposed of in the septic systems at various times.

Phase I sampling to confirm the presence or absence of radioactive or hazardous wastes in the septic systems or their discharge areas are discussed in Section 5.5.4 of this Work Plan. For the sampling plan, the TA-51 SWMU septic system will be combined with the TA-54 SWMU septic systems, discussed in Section 5.5.1, to form a TA-51/54 Septic System SWMU Aggregate.

The locations of the septic systems, their periods of operation, and sources from which they received sanitary wastes are documented and discussed in Section 5.5.1. If the septic systems did receive radioactive or hazardous wastes, it would have been from unauthorized and undocumented discharges. The time and frequency of such discharges would be undeterminable. If evidence of radioactive or hazardous wastes is discovered during Phase I sampling, then the Phase II sampling plan will be implemented. The primary purpose of the Phase II sampling plan would be to assess the nature and extent of radioactive and hazardous wastes present.

Table 5.5-3 gives the data needs for source characterization.

5.5.3.1.2 Environmental Setting

The migration pathways for contaminants released from the septic systems have been characterized conceptually. If Phase I sampling shows radioactive or hazardous wastes have been released to the subsurface through the septic systems, Phase II sampling will be done to determine the extent of contamination of the migration pathways. Table 5.5-4 gives the data needed to characterize migration pathways.

TABLE 5.5-3
INFORMATION NEEDED FOR PHASE I SOURCE CHARACTERIZATION OF TA-51/TA-54 SEPTIC SYSTEMS[a]

1. Constituent Concentrations in Media

   SW-846 Volatile Organic Compounds (VOCs)
   SW-846 Semivolatile Organic Compounds (SVOCs)
   SW-846 Metals
   Pesticides
   PCBs
   Reactive Cyanide
   Tritium
   Gross alpha, gross beta, and gamma emitters

2. Media
   Surface Water
   Soils/sediments
   Air

a These constituents and associated analytical methods are given in the Laboratory's IWP (LANL 1991, 0553).

TABLE 5.5-4
INFORMATION NEEDED FOR PHASE I TRANSPORT PATHWAY CHARACTERIZATION OF TA-51/TA-54 SEPTIC SYSTEMS

Soils/Sediments Pathway
Respirable Dust Fraction
Erodability
Organic Carbon Content
Moisture Content
Background Concentration of Each Constituent

5.5.3.1.3 Potential Receptors

Presently, there are no known public health or environmental receptors from wastes disposed in the septic systems. If Phase I sampling at the septic systems identifies radioactive or hazardous wastes, potential public health and environmental impacts would be assessed from data obtained during a Phase II investigation. The need for this assessment would be considered during planning of the Phase II investigation.

The voluntary removal and disposal of the septic systems as sanitary waste would not be appropriate if Phase I sampling identified radioactive or hazardous wastes in the systems. A change in the preliminary identification of potential response actions at the septic systems would be based on the Phase I sampling results and would be refined by Phase II sampling results. Table 5.5-5 gives the data needed to characterize potential receptors.

5.5.3.2 TA-51/TA-54 West Data Quality Objectives

The decision processes and data quality objectives (DQOs) described in this section are specific to the TA-51/TA-54 Septic System SWMU Aggregate. The subsection format follows the more general process described in detail in Section 1.4. The reader is referred to Section 1.4 for definitions of terms and decision criteria and to Figure 1.4-1 for the decision flow chart.

5.5.3.2.1 TA-51/TA-54 West Decision Process

Decision Point 1:

On the basis of existing information, is there any potential risk to human health or the environment from the septic systems at TA-51/TA-54 (Western Part)

There is no information that hazardous waste, hazardous constituents, or radionuclides have been disposed in the septic systems at TA-51/TA-54 (Western Part).

Decision Point 2:

Is existing information sufficient to allow development of a Phase II sampling plan?

No. There is no information that hazardous waste, hazardous constituents, or radionuclides have been disposed in the septic systems at TA-51/TA-54 (Western Part). Therefore, a Phase I Sampling and Analysis Plan (SAP) will be executed. As quantitative data become available, Phase I SAPs will be revised as appropriate. Data acquired in the Phase I investigation will serve as input to the next decision (Figure 1.4-1).

TABLE 5.5-5
INFORMATION NEEDED FOR PHASE I POTENTIAL RECEPTOR CHARACTERIZATION ACCORDING TO TA-51/54 CONCEPTUAL MODEL

1. General Land Use

   Local use and possible future use of the sites:
   a. Restricted access under DOE control of operable unit
   b. Recreational access under management by Bandelier National Monument
   c. Native American access to archeological sites under institutional control.

2. Demography

   A demographic profile of the people who use or have access to the sites and adjacent land, including, but not limited to: age; sex; and sensitive subgroups. These receptor groups will be investigated if Phase II sampling is undertaken.

3. Biota

   A description of the biota on, adjacent to, or affected by the sites. These receptor groups will be investigated if Phase II sampling is undertaken.

4. Ecology

   A description of the ecology overlying and adjacent to the sites will be provided if Phase II sampling is undertaken.

5. Endangered/Threatened Species

   A description of any endangered or threatened species near the sites.

6. Risk Assessment

   The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 version of the Installation Work Plan. This approach will be developed in adequate time for data analysis.

Decision Point 3:

Do the data collected in Phase I sampling confirm the presence of COCs at TA-51/TA-54 West?

This question is addressed by the DQO process for TA-51/TA-54 (Western Part). The DQOs for Phase I SAPs follow the format of Section 1.4.3.1, and the diagram shown on Figure 1.4-2.

Problem Statement

It is not known whether constituents of concern are present in the septic systems.

Questions to be Answered

Are there constituents of concern present in air, water, soils, or sediments above background levels or above health-risk based action levels?

Decision Inputs/Data Needs for TA-51/TA-54 (Western Part)

Constituents of concern (COCs) for TA-51/TA-54 West are summarized in Table 5.5-6. Volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and metals are specified in the Generic QAPjP (LANL 1991, 0412), and action levels for many of the constituents are available in Proposed RCRA Subpart S.

No suite of radionuclides of concern (ROCs) is specified in Proposed RCRA Subpart S. The Phase I sampling plans include measurements of gross alpha and gross beta radioactivity, as well as gamma spectroscopy of samples.

The Phase I SAPs were developed to determine the COC concentration in each environmental transport medium in the conceptual model (Figure 5.5-3). The COCs in each transport medium of the Phase I SAPs are summarized in Table 5.5-6.

Decision Domain

The spatial domain includes all of TA-51/TA-54 (Western Part) and excludes the adjacent canyons, which are addressed in OU 1049. The septic system SWMUs are located on land controlled by DOE. Future land use scenarios are discussed in Section 1.0.

Decision Rule/Logic Statement

The decision made at Decision Point 3 will be based on the following rule: If, at an individual septic system, the maximum concentration of any COC in any sample does not exceed action levels or the natural background concentration, that septic system will be recommended for NFA.

The Phase I plans discussed below have been designed to determine if suspected COCs are present or absent. The ER Program is currently developing baseline risk

TABLE 5.5-6
CONSTITUENTS OF CONCERN ADDRESSED IN ENVIRONMENTAL TRANSPORT MEDIA AT TA-51/54-WEST

Transport Media	Constituents of Concern[a]	Phase I SAP (Section Number)
Subsurface Soils (Cores)	EPA Protocol[b] VOCs[c], SVOCs[d], metals, pesticides, PCBs[e], cyanide, tritium, gross alpha, beta, gamma radioactivity	5.5.4

[a] Specific compounds are listed in the indicated SAP
[b] EPA 1983, 0288 for water; EPA 1987, 0518 for sediment and soil
[c] Volatile Organic Compounds
[d] Semivolatile Organic Compounds
[e] Polychlorinated biphenyls

assessment scenarios and criteria that will be presented in the 1992 version of the Installation Work Plan (IWP). This approach will be developed in adequate time for data analysis. The results of the Phase I SAPs for the septic system SWMUs will be used to validate transport models, to provide initial health risk estimates, and to develop more comprehensive Phase II SAPs, if required.

Acceptable Uncertainty Limits

Because site and waste characterization data are lacking for the septic system SWMUs, it is not possible to determine true risk ranges and tolerance limits. The characterization data needed to develop Phase II SAPs and perform health-risk assessments will be determined using the results of Phase I sampling and the risk assessment approach to be outlined in the 1992 IWP.

5.5.3.2.2 Approach to DQO Process

The Phase I sampling plan will rely on four levels of analytical data to allow a determination of precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters. The results of this determination will guide the development of the Phase II sampling plan, if it is needed. The four levels of analytical data to be used during Phase I sampling activities are:

- Level I — field screening to guide the selection of sampling locations for laboratory analyses;
- Level II — field analysis to confirm Level I field screening results;
- Level III — laboratory analyses for VOCs, SVOCs, metals, pesticides, PCBs, and cyanide; and
- Level V — laboratory analyses at a laboratory with approved SOPs for tritium, gross alpha, gross beta, and gamma spectroscopy.

The pathways of concern for this SWMU Aggregate include surface water runoff, surface sediment transport, and atmospheric dispersion. It is important to characterize the septic systems to determine if COCs are absent or present. If COCs are present during Phase I sampling, then Phase II sampling will be necessary to determine the extent of contamination. These data will be used to assess health risk and to subsequently develop remediation alternatives.

The health risk-based assessment will rely heavily on the data acquired during the Phase I and Phase II sampling and analysis activities. The use of Level III and Level V data, described above, provides the required degree of accuracy, precision, and defensibility of data that are needed to assess risk to human health and the environment.

5.5.2.3 Phase I Field Investigation

Phase I data collection at the septic system SWMUs is intended to accomplish the following:

- determine the presence or absence of contaminants in the septic systems by sampling the septic tanks, the seepage pit, and the seepage trenches; and
- make a preliminary assessment of the nature and extent of contaminants, if present, by installing a borehole in the seepage pit.

5.5.3.2.4 Phase II Field Investigation

The Phase II sampling plan will be implemented, if necessary, following evaluation of the results of Phase I sampling and analysis. The Phase II sampling plan may be performed to assess contaminant source and determine the extent of contaminants identified by Phase I.

5.5.4 TA-51/54 Septic System SWMU Aggregate Sampling Plan

There are four active septic systems in the TA-51/54 Septic System SWMU Aggregate which have been recommended for field investigation. These septic systems and their subsurface discharge areas are designated as SWMUs 51-001 and 54-007(c,d,e) (see Figures 5.5-1 and 5.5-3).

5.5.4.1 Sampling and Analysis Components

The purpose of this sampling program is to collect technically accurate and legally defensible data which can be used to determine whether radioactive or hazardous wastes have been disposed of in the septic systems and released to the subsurface through their trenches or seepage pit. Additionally, if contaminants are identified by the sampling program, the data will provide information for a preliminary assessment of the nature and extent of contamination. The sampling component of this program consists of collecting sludge samples from four septic tanks and soil samples from one seepage pit and two seepage trenches. The analytical component consists of field screening of septic tank air spaces, sludges, and subsurface soils, and laboratory analysis of sludges and subsurface soils. Field screening of sludge and soil samples will be done for VOCs and gross alpha, beta, and gamma radiation. Field screening of the septic tank air space will be done for combustible gases and oxygen concentration in addition to VOCs and gross alpha, beta, and gamma radiation. Laboratory analysis will be conducted on sludge and soil samples for VOCs and SVOCs, metals, pesticides, polychlorinated biphenyls (PCBs), cyanide, gross alpha, gross beta, and gamma emitters. The data will be validated according to the U.S. Environmental Protection Agency (EPA) functional guidelines for organic analysis (EPA 1988, 0293) and inorganic analysis (EPA 1986, 0296).

5.5.4.2 Sampling and Analysis Approach

The sampling program at the Septic System SWMU Aggregate will be implemented in a phased approach. An initial Phase I investigation will be performed to determine whether radioactive or hazardous wastes have been disposed of in the septic systems and released to the subsurface through their discharge areas. Although contaminants are not expected to be found, a Phase II investigation will be implemented if COCs are present during Phase I sampling. These data will be used to support DQO decisions.

5.5.4.3 Primary Data Quality Factors

5.5.4.3.1 Prioritized Data Uses

The data to be collected is necessary for site characterization and preliminary assessment of the nature and extent of contamination.

- Site Characterization - The historic information concerning the septic systems indicates that they received sanitary and animal wastes and no radioactive or hazardous wastes. Because septic systems service numerous drains which are not monitored, this historic information needs to be confirmed. The primary use of the Phase I data is to determine the presence or absence of radioactive and hazardous contaminants in the septic systems.

- Preliminary Assessment of the Nature and Extent of Contamination - The Phase I investigation is designed to provide preliminary information on the nature and extent of potential contaminants. This information will assist in the development of a VCA to remove the septic system, if appropriate.

5.5.4.3.2 Appropriate Analytical Levels

Samples collected will be screened in the field and analyzed by a laboratory using EPA SW-846 (third edition) protocol. Photoionization Detectors (PIDs), Combustible Gas Indicators (CGIs), and alpha, beta, and gamma radiation meters will be used in the field to screen for organic vapors and ionizing radiation immediately after samples have been collected.

The analytical levels, type of analysis (field screening or laboratory), and analytical equipment employed are summarized as follows:

Level I Field Screen: PID and CGI screen instruments; alpha, beta, and gamma radiation meters,

Level II Field Analysis: Field GCI with PID,

Level III SW-846 Laboratory Methods, and

Level V Radionuclide Analysis Laboratory Methods.

5.5.4.3.3 Primary Contaminants of Concern

The contaminants of concern for this SAP are VOCs, SVOCs, metals, pesticides, PCBs, cyanide, gross alpha, gross beta, and gamma emitters.

5.5.4.3.4 Levels of Concern

Appendix F of the IWP (LANL 1991, 0553) and 40 CFR 264, Proposed Subpart S, contain information on constituent levels of concern. Health risk-based determinations of levels of concern will be developed for constituents not listed in Appendix F. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 IWP. This approach will be developed in adequate time for data analysis.

5.5.4.3.5 Required Detection Level

Quantitation limits for laboratory analysis of radioactive and hazardous analytes in soils and sludges are presented in Tables V.3 through V.9 of the Laboratory's Generic Quality Assurance Project Plan (QAPjP) (LANL 1991, 0412).

5.5.4.3.6 Critical Samples

Samples collected from the sludges in the septic tanks are important for determining whether radioactive or hazardous wastes were disposed in the septic systems. Samples collected from the seepage pit and trenches are important for making a preliminary assessment of the nature and extent of contamination, if contaminants are present.

5.5.4.4 Rationale for Sampling Activity

The rationale for sampling at the septic systems is as follows:

- to determine whether radioactive or hazardous contaminants are present in the septic systems; and
- to provide a preliminary assessment of the nature and extent of contaminants, if they are present.

A logic flow diagram for the field investigation of the septic systems and their discharge areas is shown on Figure 5.5-5.

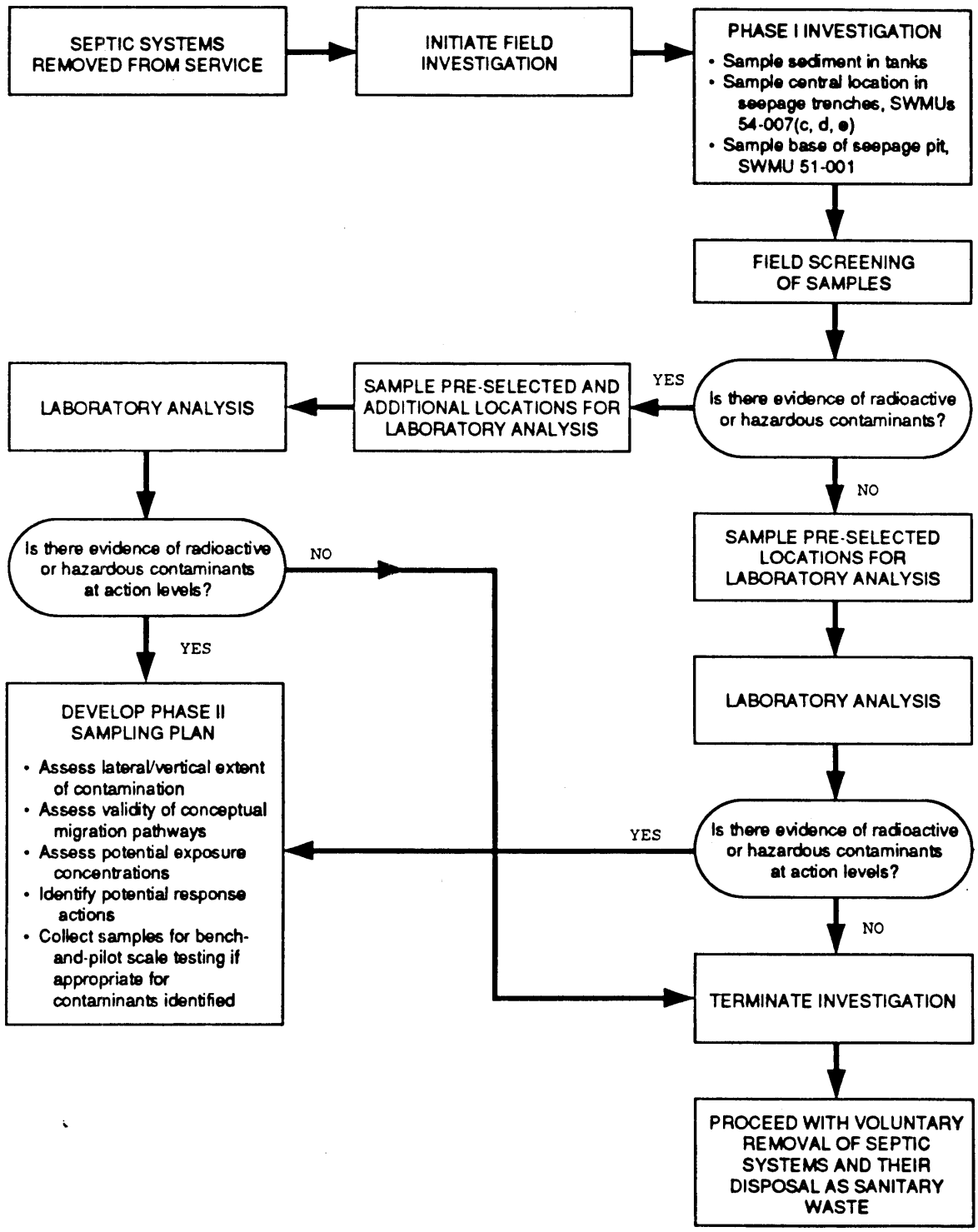


Figure 5.5-5 Logic flow diagram for the field investigation of the septic systems and their discharge areas, SWMUs 51-001 and 54-007 (c, d, e).

5.5.4.5 Sampling Activity

5.5.4.5.1 Sampling Tasks

Sampling at the septic systems is divided into three tasks: septic tank sludge sampling, test pit excavation, and borehole installation. These tasks are described below.

5.5.4.5.1.1 Septic Tank Sampling

Four septic tanks, SWMUs 51-001 and 54-007 (c,d,e), will be sampled. The locations of the septic systems are known from as-built utility plans and the septic tank access ports, which are above ground. As a result, geophysical surveys are not planned for the septic systems.

- Prior to sampling, the septic tanks will be removed from service and the sanitary liquids in them will be removed and treated.
- Field screening of the atmosphere inside the tank will be performed for health and safety concerns and contaminant identification.
- Measurement of the depth of the sludge in each tank will be performed at a minimum of three locations (along the centerline of the tank, at each end, and at the middle).
- Three samples will be collected for field screening for VOCs and ionizing radiation (one from each end of the tank and one from the middle).
- Samples will be collected for laboratory analyses of VOCs from three locations with minimal disturbance of the sludge matrix during sampling. The three samples will be collected from each end and from the middle of each tank.
- Samples will be collected for the other laboratory analyses. Samples will be collected from each end and the middle of the tank. The samples will be composited before being containerized.

5.5.4.5.1.2 Seepage Trench Sampling

Two seepage trenches, SWMUs 54-007 (c,d,e), will be sampled.

- The seepage trench sampling will be performed after completion of Task 1, Septic Tank Sampling. If field screening at the septic tanks indicates the presence of contaminants, appropriate health and safety precautions will be taken and a second location in the seepage trench at the end nearest the septic tank will be sampled.

- The primary seepage trench sampling location will be near the center of each trench. If field screening indicates the presence of contamination at a trench sampling location, a total of three locations in the trench will be sampled; one near the septic tank, one in the middle, and one at the end farthest from the septic tank.

- The seepage trenches will be sampled from test pits advanced at six-inch intervals at a maximum. Field screening will be performed on representative samples from each interval.

- Each pit will be advanced to a depth one foot below the observed depth of discharge infiltration or one foot below the indicated depth of contamination by field screening, whichever is deeper.

- At each sampling location, a sample for laboratory analyses will be collected from the depth of the highest field screening readings or from the depth of greatest staining from septic system discharge if there are no field screening readings above background levels. This will probably be immediately beneath the drainage tiles.

- Each test pit will be logged, including information on the type of soil or tuff excavated, field screening results, and observed staining from septic system discharge.

- Each test pit will be backfilled with material from the pit, as the turnaround time for the laboratory analyses will probably be a minimum of 60 days.

5.5.4.5.1.3 Seepage Pit Sampling

One seepage pit, SWMU 51-001, will be sampled.

- The seepage pit sampling will be performed after completion of Task 1, Septic Tank Sampling.

- The seepage pit will be sampled through a borehole advanced near its center.

- Field screening will be performed on at least one sample from every five feet of borehole.

- One sample for laboratory analyses will be collected from the base of the pit at approximately 40 feet.

- The borehole will be advanced to a depth five feet below the base of the pit, and a second sample for laboratory analysis will be collected.

- The borehole beneath the base of the pit will be sealed with a mixture of cement grout and six percent bentonite.

- The borehole in the seepage pit will be backfilled with cuttings.

A summary of the field screening and laboratory analyses to be performed at each individual SWMU in the TA-51/54 Septic System SWMU Aggregate is presented in Table 5.5-7.

5.5.4.5.2 Sample Collection

5.5.4.5.2.1 Septic Tank Sludge Sample Collection

Prior to sampling, the air space of a septic tank will be monitored for VOCs with an 11.7 eV PID; combustible gases and oxygen content by a CGI; and alpha, beta, and gamma radiation by radiation survey meters. This will allow for appropriate health and safety precautions during the sampling activities.

Sampling will begin with measurements of the thickness of the sludge at each end and the middle of the tank using a dowel rod or similar device. Sludge samples will be collected with a long-handled scoop. Polypropylene scoops with screw-on extensions and scoop ends are recommended for this sampling. The length is easily adjusted and the scoops are autoclavable for decontamination, or a new scoop end can be screwed onto the extensions between sampling at different tanks.

Three samples from each tank, one from each end and one from the center, will be collected for field screening. Each sample will be screened for alpha, beta, and gamma radiation with appropriate meters. A headspace analysis for VOCs will also be performed using an 11.7 eV PID. The headspace analysis method is as follows:

- Place some sludge in a 500-ml/16-ounce or larger jar.
- Seal the top of the jar with Teflon® or a nonvolatile plastic wrap, such as Tedlar® or equivalent.
- Heat the sludge to a temperature of 15° to 25°C in a microwave or similar type oven to release the vapors.
- Pierce the seal with the probe of the PID and read the highest (peak) measurement.
- Record the results and any pertinent observations on the sample collection log.

After the field screening has been completed, laboratory samples will be collected using a long-handled scoop. Three locations in each tank will be sampled for VOCs with minimum disturbance of the sludge matrix. These three sampling locations will be from each end and from the middle of each tank. After the volatile samples are collected, a composite sample for the remaining analytes will be collected. The composite sample will be collected from each end and from the center of each tank.

Table 5.5-7

Screening and laboratory analysis for Phase I investigations at TA-51/54 Septic System SWMU Aggregate.

Sample Location	No. of Samples	Sample Description	Level I Field Screening: Gross Alpha, Beta, Gamma	Organic Vapors by 11.7eV PID	Combustible Gas/Oxygen	Lithologic Logging	Level III and Level V Laboratory Measurements: Pesticides/PCBs	Cyanide	Gross Alpha, Beta, Gamma	VOCs	SVOCs	Metals
51-001 Septic Tank	1	Tank airspace monitoring	X	X	X							
51-001 Septic Tank	3	Sludge	X	X								
51-001 Septic Tank	2	Undisturbed sludge								X		
51-001 Septic Tank	1	Composite sludge					X	X	X		X	X
51-001 Seepage Pit	~ 10	Subsurface soil (1 sample from each 5 ft. core)	X	X		X						
51-001 Seepage Pit	2	Subsurface soil					X	X	X	X	X	X
54-007(c) Septic Tank	1	Tank airspace monitoring	X	X	X							
54-007(c) Septic Tank	3	Sludge	X	X								
54-007(c) Septic Tank	2	Undisturbed sludge								X		
54-007(c) Septic Tank	1	Composite sludge					X	X	X		X	X
54-007(d) Septic Tank	1	Tank airspace monitoring	X	X	X							
54-007(d) Septic Tank	3	Sludge	X	X								
54-007(d) Septic Tank	2	Undisturbed sludge								X		
54-007(d) Septic Tank	1	Composite sludge					X	X	X		X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

Table 5.5-7

Screening and laboratory analysis for Phase I investigations at TA-51/54 Septic System SWMU Aggregate.

			Level I Field Screening					Level III and Level V Laboratory Measurements										
Sample Location	No. of Samples	Sample Description	Gross Alpha, Beta, Gamma		Organic Vapors by 11.7eV PID		Combustible Gas/Oxygen	Lithologic Logging		Pesticides/PCBs		Cyanide		Gross Alpha, Beta, Gamma		VOCs		SVOCs		Metals
54-007(c)(e) Seepage Trench	10 to 30	Subsurface soil	X		X			X												
54-007(c)(e) Seepage Trench	1 to 3	Subsurface soil								X		X		X		X		X		X
54-007(d) Seepage Trench	10 to 30	Subsurface soil	X		X			X												
54-007(d) Seepage Trench	1 to 3	Subsurface soil								X		X		X		X		X		X
54-007(e) Septic Tank	1	Tank airspace monitoring	X		X		X													
54-007(e) Septic Tank	3	Sludge	X		X															
54-007(e) Septic Tank	2	Undisturbed sludge														X				
54-007(e) Septic Tank	1	Composite sludge								X		X		X				X		X
Trip Blank	2	Water														X				
Field Duplicates	2	Soil	X		X			X		X		X		X		X		X		X
Rinsate Blanks	2	Water								X		X		X		X		X		X
Field Blank	2	Water								X		X		X		X		X		X

X : Indicates an interval where a planned screening or analysis sample will be collected.

Compositing will be done according to the method in LANL-ER-SOP-06.11, "Stainless Steel Surface Soil Sampler."

5.5.4.5.2.2 Test Pit Excavation and Sample Collection

A minimum of one and a maximum of three test pits will be excavated at each of two seepage trenches, SWMUs 54-007(c, e) and 54-007(d). Each test pit will be excavated in six-inch intervals to a total depth one foot below evidence of septic system discharge or contamination. The septic system seepage trenches are thought to be 2 to 3 feet deep. Total excavation depth of approximately 5 feet is anticipated.

The test pits will be excavated with a backhoe or trackhoe capable of excavation to an approximate depth of ten feet. Samples will be collected from the hoe bucket. This will require scraping of the bucket with shovels or other devices to remove most of the soil between each six-inch interval. If it is desirable to sample directly from the test pit, such as scooping a sample from beneath the drainage tiles, this can be done if the pit is less than four feet deep.

A geologist will be present during excavation operations at test pits and will maintain a detailed log. The log should include the following information:

- Detailed soil, fill, or rock description including:
  - Soil, Fill, or Rock Type
  - USCS classification
  - Color
  - Mineralogy
  - Bedding thickness
  - Grain or crystal size
  - Hardness
  - Weathering
  - Moisture content - listed as an adjective (e.g., dry, moist, wet)
- Location of any fractures, joints, bedding planes, faults, cavities, or weathered zones intercepted during excavation.
- Fracture orientation and spacing.
- Location of mineralized zones indicating the minerals present.
- PID screening and monitoring results.
- Alpha, beta, and gamma radiation screening results.
- Depth/elevation of sampling interval.
- Sampling methods.
- Equipment details, including type of hoe.
- Total depth of test pit.
- Identification numbers of samples, blanks, and duplicates.

One sample of each six-inch interval will be collected from the hoe bucket for field screening. Field screening will be for alpha, beta, and gamma radiation with appropriate meters and for VOCs by headspace sampling using an 11.7 eV PID. For the headspace sampling, soil will be broken up and placed in a 0.5-liter/16-ounce jar,

and then the steps described previously in this section for septic tank sludge headspace analysis will be followed.

One sample for laboratory analyses for the full suite of analytes will be collected from each test pit. This sample will be collected from the depth of the highest contamination as indicated by field screening or from the depth of the greatest staining observed if no contamination was indicated by field screening. This sampling depth is anticipated to be directly beneath the drainage tiles and may be collected directly from the trench with a teflon or stainless steel scoop if the trench is less than four feet deep.

5.5.4.5.2.3 Borehole Installation and Sample Collection

One borehole is planned at the seepage pit (SWMU 51-001) as part of the Phase I septic system investigation. The borehole will be advanced to a minimum depth of 50 feet, which is 10 feet below the base of the pit.

The borehole will be advanced by hollow stem auger techniques using a Failing Model F-10, or equivalent drill rig. The borehole will be advanced with 7.625-inch outside diameter by 4.25-inch inside diameter augers. Samples will be collected with a 3.25-inch inside diameter five-foot-long split barrel continuous sampling tube. A wireline retrieval system will be used to return the sampling tube to the surface.

A geologist will be present during drilling operations and will maintain a detailed log for the borehole. Consult LANL-ER-SOP-06.12, "Soil and Rock Borehole Logging and Sampling Methods," for information on completing the borehole log. The borehole log should include the information listed in Section 3.2 of Appendix B.

Continuous collection of fill, sludge, and soil material throughout the length of the borehole will be conducted for logging and sampling purposes. Refer to LANL-ER-SOP-06.12, "Soil and Rock Borehole Logging and Sampling Methods," for information on sample collection. Soil samples will be collected in five-foot sections for various analyses and measurements in the field and the laboratory, including gravimetric moisture content every five feet.

Upon retrieval of the core barrel, the contents will be screened for radioactive and hazardous contaminants. The entire length of core will be scanned for ionizing radiation with appropriate alpha, beta, and gamma meters and for VOCs with an 11.7 eV PID. After the core is logged, a sample from each five-foot core will be broken up and placed in a 0.5-liter/16-ounce jar for headspace sampling using an 11.7 eV PID. The steps described previously in this section for septic tank sludge headspace analysis will be followed.

Samples for laboratory analyses will be collected at the specified depths. Field screening results and observed staining will be used to select the exact core section for laboratory sampling by selecting the section most likely to be contaminated. Samples for laboratory analyses for VOCs and tritium will be collected first with minimal disturbance of the sample matrix. Samples for laboratory analyses for the remaining analytes of the full suite will be collected from a composite of a section of

core long enough to provide a sufficient volume of sample. Compositing will be according to the method in LANL-ER-SOP-06.11, "Stainless Steel Surface Soil Sampler."

After logging, screening, and sampling of a core section, it will be transferred to a core box. Specific details of how to handle the core are given in Section 3.3.1 of Appendix B.

5.5.4.5.3 Field Screening of Samples for Health and Safety Purposes

Immediately upon retrieval of a sludge sample from a septic tank, a hoe bucket from a test pit, or a core barrel from a borehole, the Site Safety Officer will scan the sample for radioactive and hazardous constituents. The results will be recorded on the Sample Collection Log. If ionizing radiation or organic vapors are detected, refer to Figure B-1, "Sample Management Decision Flow Chart," for instructions; otherwise continue with sample collection efforts.

5.5.4.5.4 Waste Disposal/Test Pit and Borehole Abandonment

The septic tank systems, including the seepage trenches and pit, are not expected to be contaminated with radioactive or hazardous wastes. The septic systems are scheduled for voluntary removal and disposal as sanitary waste subject to verification of the absence of contaminants by the Phase I sampling and analysis. As a result, test pits will be backfilled with the materials removed from them until sampling results are available to determine the ultimate disposal method of the entire septic system. The borehole below the base of the seepage pit will be sealed with a six percent bentonite and cement grout mixture to prevent it from becoming a migration pathway. Because the entire seepage pit will be removed for disposal, the borehole within the pit will be backfilled with the cuttings which came from it. Other solid wastes generated during the sampling, such as personal protective and sampling equipment, may be placed in the septic tanks for eventual disposal with the septic tank sludge.

Decontamination liquids will be drummed and disposed of in accordance with LANL-ER-SOP-01.06 "Management of RFI-Generated Waste." Drums will be labeled using a permanent marker with the following information: type of material, Operable Unit identification number, Technical Area number, disposal area identification, sampling location, contact group, and telephone number. Drums will be placed in a temporary storage area designated for this purpose.

Procedures for the disposition of wastes are shown on Figure B-3 in Appendix B, "Decision Flow chart for Management of ER Program Waste Generated During the RFI."

5.5.4.5.5 Survey of Sampling Locations

The test pit and borehole locations will be staked at completion to facilitate subsequent surveying. The elevation of these points will be determined to the nearest 0.1 foot. The location of each test pit and borehole will be measured from permanent site features which will allow for later relocation of all sampling locations. These measurements will be shown on a site plan and recorded in the surveying notebook. Coordinates and elevations will be established for each test pit and borehole. The coordinates will be to the closest 1.0 foot and referenced to the State Plane Coordinate System. Elevations will be referenced to the National Geodetic Vertical Datum of 1928 (Mean Sea Level), or an existing local vertical datum.

5.5.4.5.6 Health and Safety Screening Measurements

Screening measurements will be taken in septic tank, test pit, and borehole headspace, and in the breathing zone during sampling activities to identify gross contamination and to assess conditions affecting the health and safety of field personnel. Application of screening for personnel health and safety is detailed in the Health and Safety Plan. Every sample collected will be screened for ionizing radiation and organic vapors. The septic tanks, test pits, and borehole will be monitored for alpha, beta, and gamma radiation, combustible gases, and organic vapors. Screening results will be recorded on the Daily Activity Logs and Sample Collection Logs.

Alpha, beta, and gamma radiation meters and organic vapor detectors will be used to screen septic tank sludge samples, test pit samples, and borehole cores at the point of sample collection. Appropriate radiation meters and an 11.7 eV PID will be used for this purpose. A CGI will be used to determine the potential for combustion or explosion of unknown atmospheres during test pitting and drilling activities. The CGI will determine the level of organic vapors and gases present in an atmosphere as a percentage of the lower explosive limit (LEL) or lower flammability limit (LFL).

Specific action levels have been developed for guidance in handling sample and waste material generated during the field program. Follow the decision path on Figure B-1, "Sample Management Decision Flow Chart", after screening material for contamination.

5.5.4.6 Remaining SAP Elements

The remaining required elements of the SAP are common to all of the SAPs prepared for OU 1148. These common elements are presented in the Table 5.5-8 and are located in Appendix B.

5.5.4.7 Phase II SAPs

If Phase I sampling results indicate that COCs are below background and health risk-based criteria, then the site will be considered for a voluntary corrective action (VCA).

TABLE 5.5-8
FIELD SAMPLING PLAN ELEMENTS LOCATED IN APPENDIX B

1. Sample Collection Procedures
2. Field Documentation
3. Sample Preservation and Handling Procedures
4. Field Quality Assurance
5. Variance Situation
6. Equipment List
7. Equipment Calibration
8. Decontamination Procedures
9. Precision, Accuracy, Representativeness, Completeness, and Comparability Review

However, if Phase I sampling results indicate COCs above background and health risk-based criteria, the following Phase II actions will be taken.

Phase II sampling of sludge from the septic tanks is not proposed at this time. Phase I sampling should be sufficient to characterize the sludge. During the efforts to decontaminate and decommission the septic tank during VCA, samples will be taken for Toxicity Characteristic Leaching Procedure (TCLP) analysis to characterize the sludge for disposal.

It is not anticipated that COCs will be detected at the seepage trenches; however, Phase II sampling within the seepage trenches at TA-54 West will be conducted to determine the extent of COCs in excess of health risk-based concentrations. Additional test pit samples will be collected in an area immediately adjacent to any location that had an elevated level of COCs.

Phase II sampling of materials within the seepage pit at TA-51 will be conducted if the COCs are in excess of background and health risk-based concentrations. The Phase II samples will be collected from three boreholes drilled radially around the Phase I borehole location (Table 5.5-9).

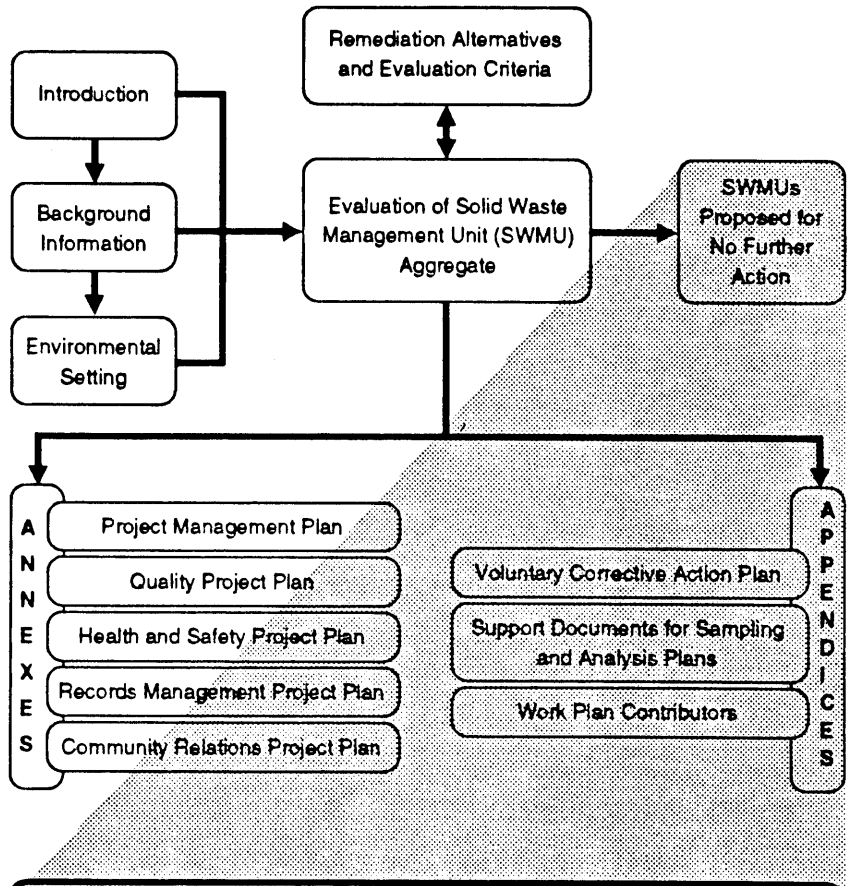
5.5.4.8 Schedule

The Phase I sampling plan will not be implemented until the septic systems are removed from service in 1992-93.

TABLE 5.5-9
PHASE II SAMPLING AT THE SEPTIC SYSTEM SWMU AGGREGATE

Media	Phase II Sampling	Rationale	Analysis	# of Samples
Sludge	0	The septic tanks will be removed.	None	0
Seepage Trench Soil/Rock	6 locations	Sample if COCs exceed health risk-based criteria.	COCs	6 + 4 QCs 10 Total
Seepage Pit Soil/Rock	3 locations	Sample if COCs exceed health risk-based criteria.	COCs	6 + 4 QCs 10 Total

CHAPTER 6



Proposed No Investigation Units

- MDA J
- MDA H
- MDA L
- MDA G
- TA-51/TA-54 (Western Part)

6.0 PROPOSED NO FURTHER ACTION UNITS

6.1 MDA J

There are no Solid Waste Management Units (SWMUs) within MDA J that are currently being recommended for no further action.

6.2 MDA H

There are no SWMUs within MDA H that are currently being recommended for no further action.

6.3 MDA L

6.3.1 Description/History

There are four SWMUs within MDA L recommended for no further action (see Figure 6.3-1).

Bermed Storage Pad [54-001(c)]

When the SWMU Report (LANL 1990, 0145) was written, a portable, inflatable temporary berm with a 20-ft by 12-ft by 5-ft steel tank inside of it was proposed to be used to store waste oil and hazardous materials at MDA L. It was designated SWMU 54-001(c). The tank was never used to store waste oil or hazardous materials; it collected only rain water. The inflatable berm and tank have been removed (Weston, 1992 08-0044).

Septic Tanks (54-008)

Three septic tanks at MDA L are used to hold sanitary wastes. The tanks are emptied by pumping wastes to a truck-mounted tank. The tanks have no seepage trenches or beds. The capacity of the first tank (TA 54-43) (SWMU 54-008) is 1,700 gal. It was installed within MDA L in 1988 and serves TA-54-39, the PCB Storage Facility. No releases have been identified from this tank. The NMED registration number for this tank is SF 880257.

The second septic tank (TA 54-80), installed outside of MDA L, serves building TA-54-37. Its capacity is 1,500 gal. The tank was installed in 1989 (IT Corporation 1991, 08-0028). Releases have occurred at least three times due to tank overflow. The septic tank receives sanitary waste from office facilities, and it is unlikely that hazardous waste enters the tank. Procedures have been revised since the overflows occurred, and scheduled removal of the waste has been increased to three times per week. This tank is not a listed SWMU. The NMED registration number is SF 89034R.

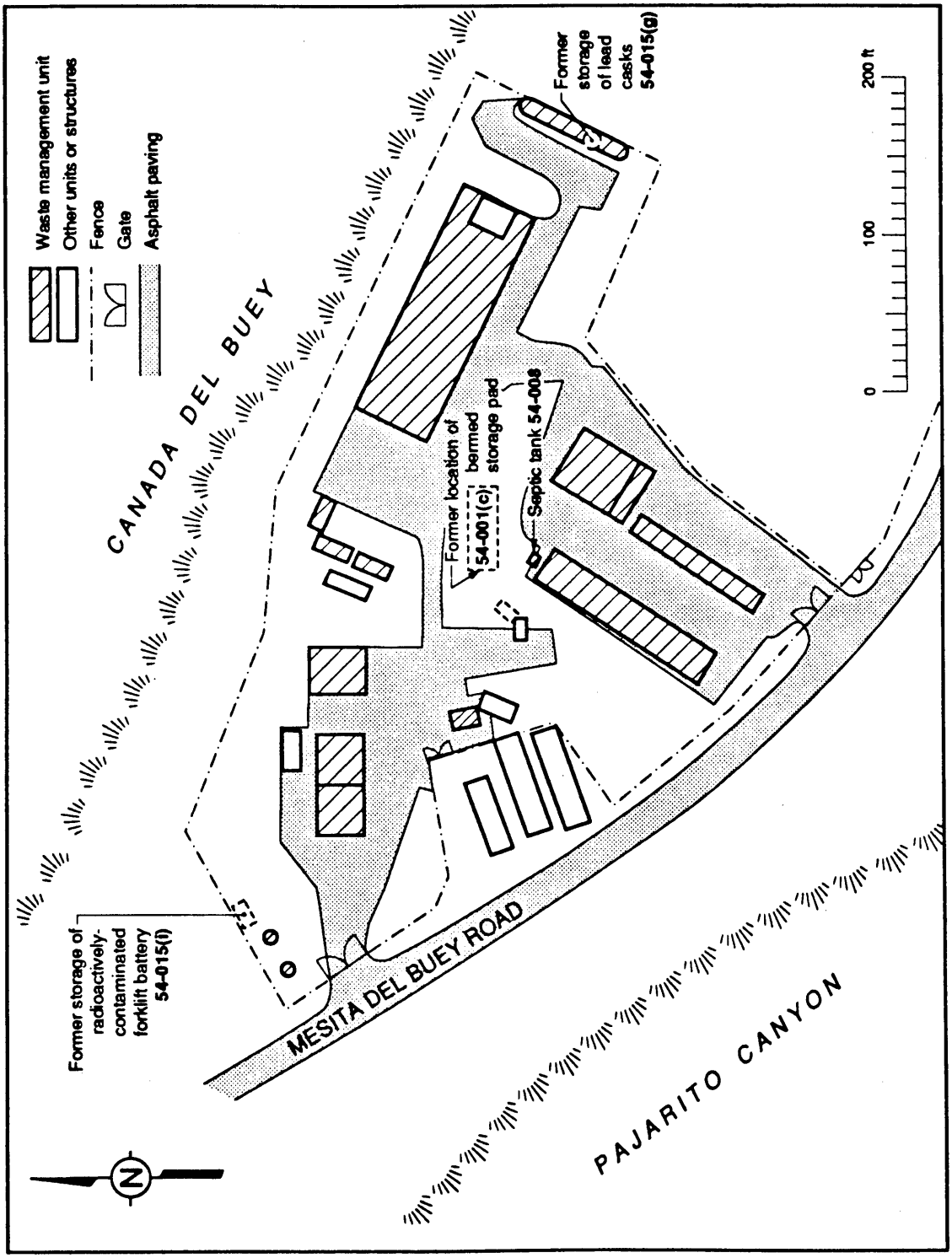


Figure 6.3-1 Location map of MDA L SWMUs recommended for no further action. (Base map modified from Benchmark Environmental Corp. 1991.)

The third septic tank (TA-54-150), also outside of MDA L, serves building TA-54-117. Its capacity is 600 gal. The tank was installed in 1990 after the more stringent waste-removal schedule had been implemented. As an extra precaution, the new tank was equipped with an overflow alarm system. No releases have been identified from this tank. This tank is not a listed SWMU. The NMED registration number is SF 880260.

Lead Casks Near Shaft 4 [54-015(g)]

At the time the SWMU Report was written, uranium-contaminated lead casks [SWMU 54-015(g)] were stored on the surface near Disposal Shaft 4 on the east side of MDA L. They were first packaged in MDA G to prevent the exposure of lead to the environment. Then they were moved to MDA L for a period of time. They have since been moved to MDA G for storage as mixed waste (IT Corporation 1992, 08-0021). No releases have been identified.

Radioactively-Contaminated Forklift Battery [54-015(i)]

At the time the SWMU Report was written, a containerized, radioactively-contaminated forklift battery [SWMU 54-015(i)] was stored just north of the lead stringer shafts in MDA L. The forklift battery is no longer at MDA L; it was overpacked and then moved to Area G for storage as mixed waste (IT Corporation 1992, 08-0021). No releases have been identified.

6.3.2 Rationale for NFA

Table 6.3-1 presents the rationale for SWMUs in MDA L that are recommended for no further action.

6.4 MDA G

6.4.1 Description/History

There are five SWMUs within MDA G that are currently recommended for no further action (see Figure 6.4-1).

Empty Drum Storage Area [54-001(f)]

When the SWMU Report was written, the equipment storage area [SWMU 54-001(f)] east of the transuranic (TRU) storage pads 1-4 were included in a hazardous waste container storage area, but no information on waste handling was available. Since then, Laboratory personnel at EM-7 have confirmed that no waste was ever handled or stored at this area (IT Corporation 1992, 08-0005).

TABLE 6.3-1
SWMUs IN MDA L RECOMMENDED FOR NO FURTHER ACTION

SWMU	Rationale
54-001(c) Open-top tank inside an inflatable berm	Never managed any hazardous waste or hazardous waste constituents, and has been removed from MDA L. This SWMU no longer exists.
54-008 Septic tank and two additional tanks not listed as SWMUs	These are active units that do not manage hazardous wastes. They are registered with the NMED and will be used beyond the year 2000.
54-015(g) Lead casks	The casks were containerized at MDA G prior to storage at MDA L. The containerized casks were overpacked and returned to MDA G for storage as mixed waste. Since the lead casks were containerized, there is no potential impact to the environment as the result of storage at MDA L.
54-015(i) Forklift battery	The battery was containerized before storage at MDA L, and overpacked before storage at MDA G. There is no potential impact to the environment as a result of the storage of this battery at MDA L.

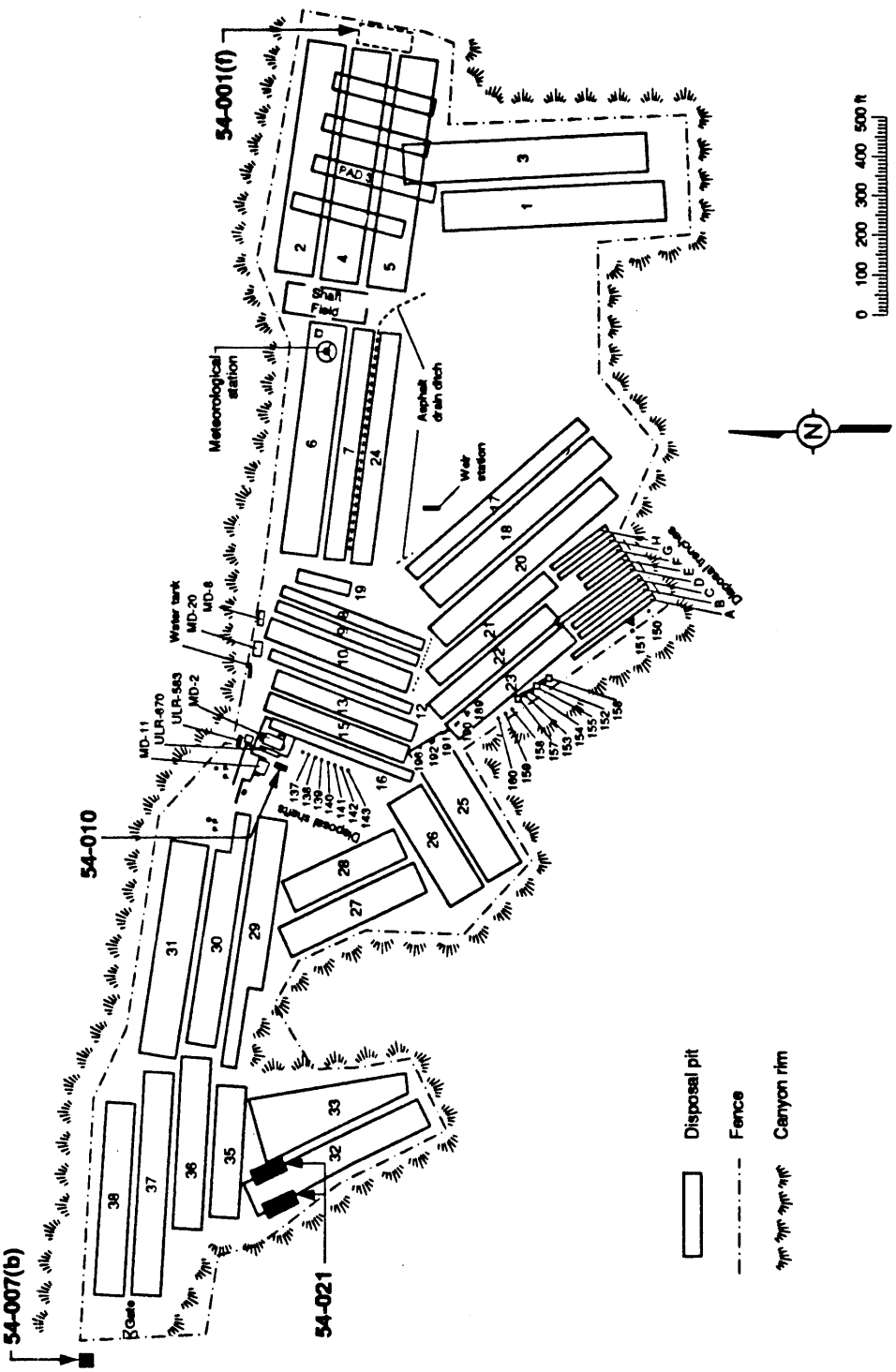


Figure 6.4-1 Location map of SWMUs recommended for no further action at MDA G, TA-54.

Septic Tank [54-007(b)]

A septic tank (TA-54-28) is listed in the SWMU Report (LANL 1990, 0145) as a septic system and seepage pit that has a State of New Mexico license number LA-61. The SWMU [54-007(b)] is a septic system that is scheduled for removal in 1992. The septic system served office building TA-54-22. The building and the septic system are located outside of MDA G, approximately 300 ft west of the perimeter fence. Documentation of scheduled removal date is pending.

Supply Wash Water Tank (54-010)

A tank is listed in the SWMU Report (LANL 1990, 0145) as a 600-gal tank used to hold wash water from decontamination activities of items from the waste compaction operations in TA-54-2, and shower water from TA-54-11. Since then, Laboratory personnel at EM-7 have confirmed that this tank (SWMU 54-010) actually holds supply wash water instead of waste water (IT Corporation 1992, 08-0005). As such, this tank is not part of a waste stream.

Six Empty Waste Oil Tanks (54-021)

Six tanks (SWMU 54-021) stored at MDA G have been removed under a RCRA closure plan. The Laboratory closure report was submitted to the NMED, and is awaiting approval. The tanks were originally located at MDA L, where they were used to store waste oil (see Section 5.3).

PCB Transformer Spill (54-022)

A PCB transformer spill site (SWMU 54-022) is listed in the SWMU Report (LANL 1990, 0145) as the site where a transformer is known to have leaked. The transformer was removed on October 1, 1989, and cleanup was implemented. According to Johnson Controls World Services Inc. standard procedures, any spills were to be cleaned up within 24 hours (IT Corporation 1992, 08-0003, 08-0006). Documentation of cleanup activities is pending.

6.4.2 Rationale for No Further Action

Table 6.4-1 summarizes the SWMUs in MDA G recommended for no further action.

6.5 TA-51

6.5.1 Description/History

There are three SWMUs and areas of concern (AOCs) within TA-51 that are currently recommended for no further action (see Figure 6.5-1).

TABLE 6.4-1
SWMUs IN MDA G RECOMMENDED FOR NO FURTHER ACTION

SWMU	Rationale
54-001(f) Empty drum storage	This drum storage area never handled any hazardous waste or hazard ous waste constituents.
54-007(b) Septic tank	This septic tank has been scheduled for removal.
54-010 Supply wash water truck	This tank is not part of a waste stream.
54-021 Six empty storage tanks	These tanks have been removed under a RCRA closure plan.
54-022 PCB transformer spill	Cleanup of this site has been implemented.

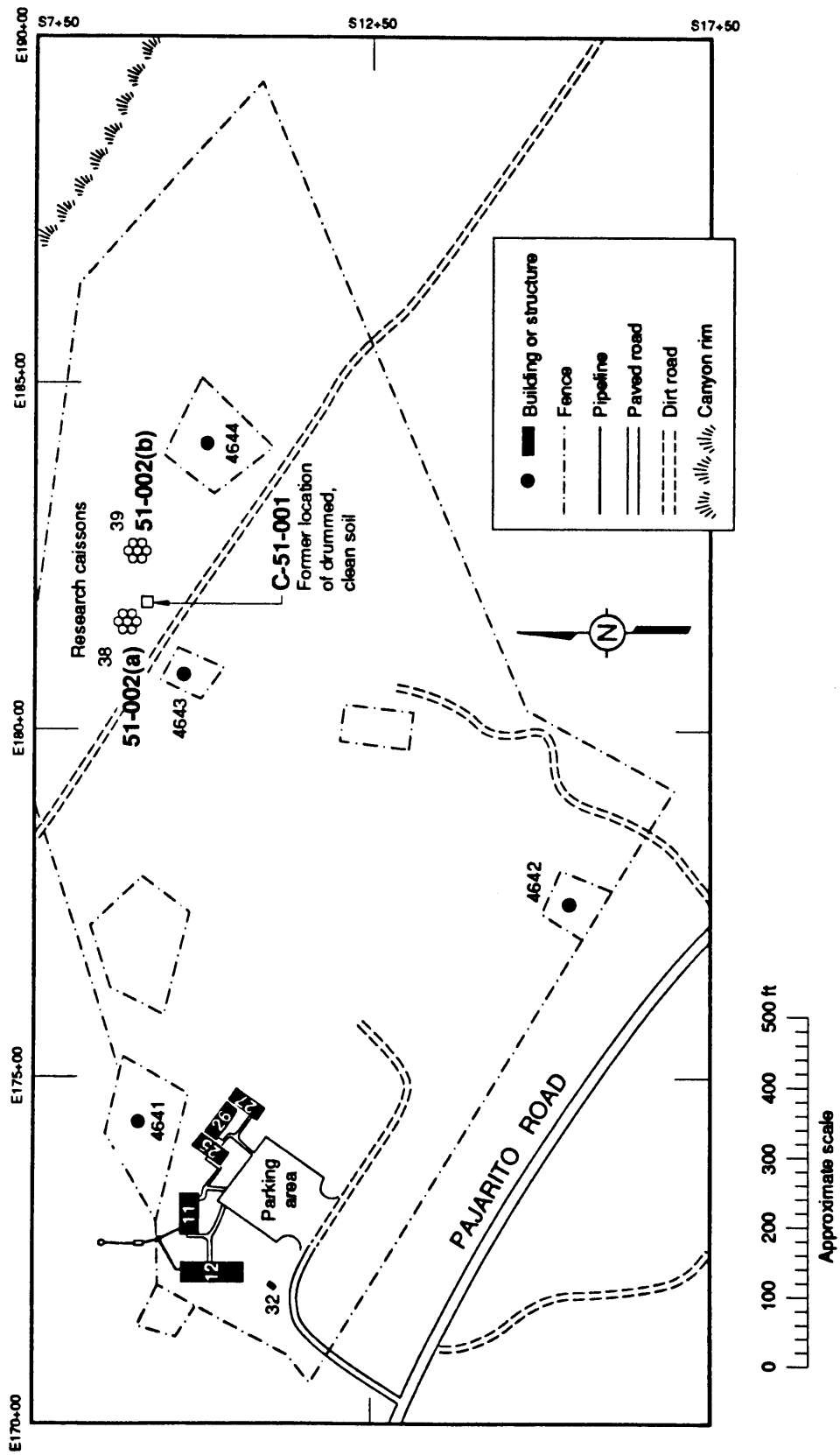


Figure 6.5-1 Location map of TA-51 SWMUs and areas of concern recommended for no further action (LANL 1983 [ENG C44263]; LANL 1984 [ENG R45128]; LANL 1985 [ENG C44821]; LANL 1990 [0145]).

Environmental Research Caissons [51-002(a,b)]

Environmental research site caissons are located at TA-51-38 [SWMU 51-002(a)] and TA-51-39 [SWMU 51-002(b)]. The structures were constructed in 1980, but only TA-51-38 was used for research. TA-51-39 is inactive and is currently sealed with steel plates to prevent if from collecting water during precipitation (Weston 1991, 08-0045). Each structure consists of radial clusters of 12 vertical steel caissons that surround a central caisson for sampling and measurement. The structures are largely underground. The caissons are 20 ft deep.

Six of the caissons on each structure are 10 ft in diameter and six are 18 inches in diameter. The design of the structures is shown on Figure 6.5-2. Research was conducted in structure TA-51-38 from 1981 to 1986. The individual large-diameter caissons in the structure are designated with the letters A through F (see Figure 6.5-2). Research was never conducted in Caisson F or in the six small-diameter caissons; they remain empty.

The research involved filling Caissons A through E with natural earth materials such as crushed tuff and crushed tuff mixed with bentonite, sand, and coarse gravel. Measurements were taken over time to characterize the flow of water and the transport of chemical tracers through the vertical columns. Tracers used in the research included stable isotopes of chemicals that are not listed as hazardous waste. No radioactive isotopes were used in the research. Experiments in Caisson E did not use tracers. Chemical tracers used in the research are listed in Table 6.5-1.

Each caisson is a closed system with a drain that collects water flowing vertically through the soil column. The drains collect to a central sump. Water in the sumps was discharged periodically to land that sloped off the mesa to Cañada del Buey. There is no specific information on the volume of water that was discharged periodically or the concentrations of tracers that were present in the discharge. However, the chemical constituents used as tracers are not a concern for environmental contamination. Therefore, SWMUs 51-002(a,b) are recommended for NFA.

Former Storage Area for Clean, Drummed Soil (C-51-001)

At the time the SWMU Report was written, drums of clean soil were present at research caisson TA-51-38. The soil was used in research at the caissons. The drums of soil were listed as AOC C-51-001 in the 1990 SWMU Report (Weston, 1991, 08-0045). There were no drums present at the site during a visit on August 22, 1991 (Weston 1991, 08-0045). There is no reason to suspect that the drums of soil contained hazardous waste constituents. Therefore, AOC C-51-001 is recommended for NFA.

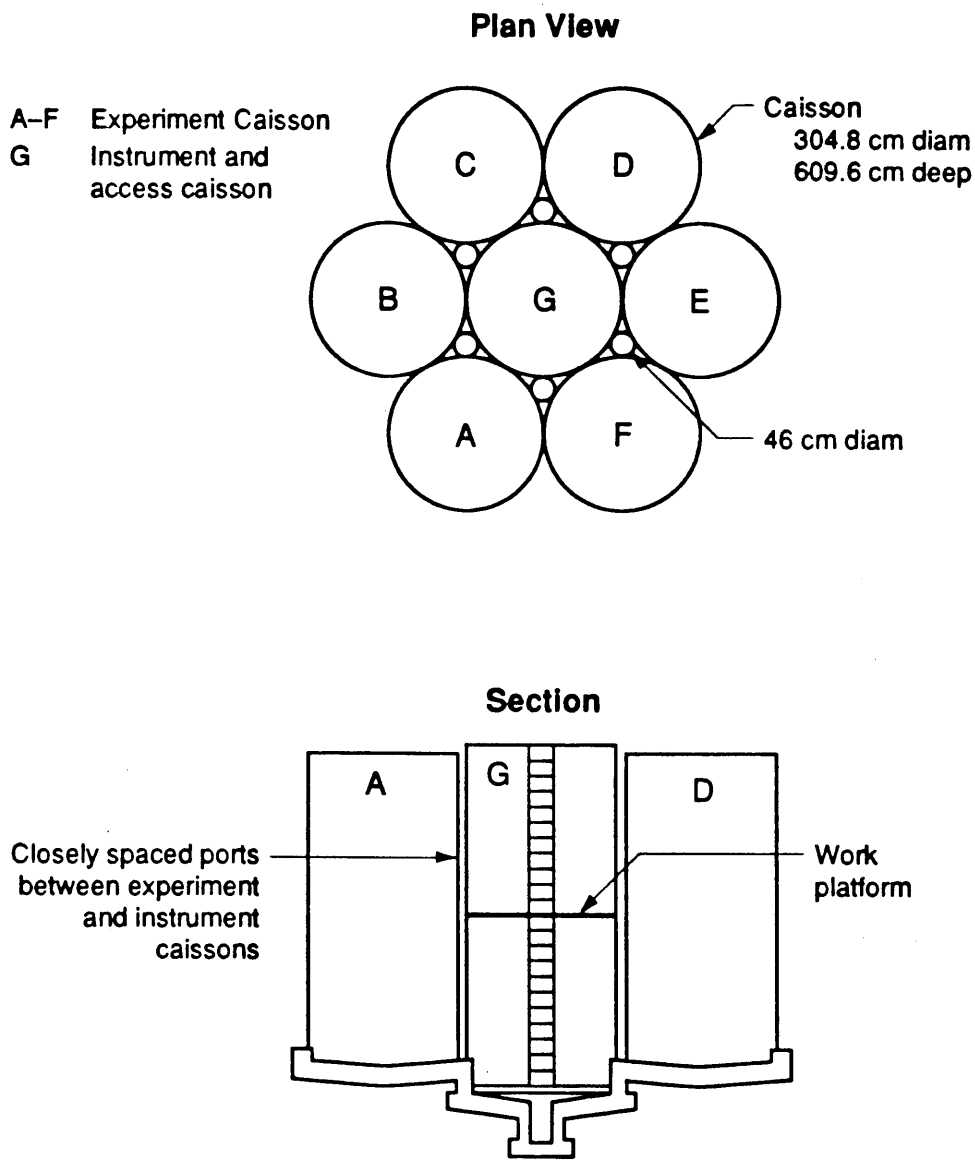


Figure 6.5-2 Structural design of environmental research site caissons.

TABLE 6.5-1
CHEMICAL TRACERS USED IN TA-51 CAISSONS

Caisson	Chemical Tracers	Reference
A	Cs, Br, I, Sr, Li, Ca, K	(Essington et al. 1986, 0496)
B	Br, I, Cs, Sr, Li	(Nyhan et al 1986, 0170)
C	Cs, Sr, Co, Cl	(Perkins and Cokal 1986, 0175)
D	Cs, Sr, Co, Cl	(Perkins and Cokal 1986, 0175)
E	No Tracers	(Nyhan et al 1986, 0169)
F	Caisson has not been use	(Weston, 1992 08-0045)

TABLE 6.5-2
SWMUs AND AOCs AT TA-51 RECOMMENDED FOR NO FURTHER ACTION

SWMU	Rationale
SWMU 51-002(a,b) Environmental research caissons	The research caissons never managed hazardous waste or hazardous waste constituents.
AOC C-51-001 Former storage area for clean, drummed soil	This storage area never managed hazardous waste or hazard ous waste constituents.

6.5.2 Rationale for NFA

Table 6.5-2 presents the SWMUs and AOCs in TA-51 that are recommended for no further action.

6.6 Western Part of TA-54

6.6.1 Description/History

There are three SWMUs and one AOC in the western part of TA-54 that are currently recommended for no further action (see Figure 6.6-1).

Truck Washing Pit [54-013(a)]

At the time the SWMU Report was written, the Laboratory planned to build a truck washing pit at TA-54 West, and it was designated as SWMU 54-013(a) in anticipation of its construction. Plans to build the facility were subsequently canceled, and no such area exists (IT Corporation 1992, 08-0021).

Drum Storage Area [54-015(h)]

A drum storage area, SWMU 54-015(h), is located in TA-54-38. The Nondestructive Testing Facility (NDT) at TA-54-38 was opened for a brief period of time in 1990, but operations have been discontinued until safety assessment requirements are met (LANL 1991, 08-0025). The facility will handle containerized TRU wastes that contain transuranic radionuclides at >100 nCi/g of waste and may contain mixed waste constituents. Because the facility is used for the NDT of TRU wastes that are already containerized, releases to the environment are considered unlikely. Discussions with Laboratory personnel indicate that no releases have occurred during the brief period since the facility was completed (IT Corporation 1992, 08-0021).

Nondestructive Testing Facility (NDT) Sump [54-016(a)]

A sump located in the NDT Facility inside building TA-54-38 receives snowmelt and rainwater which drip off of trucks entering the building. The sump has a drain which connects to a canyon outfall on the north side of the building. The drain is kept closed until water in the sump is tested. If the water is free of contaminants, it is then discharged to the canyon outfall. If contaminants are detected, the water may be pumped from the sump for proper treatment and disposal. The NDT Facility handles containerized TRU wastes. The TRU waste verification testing and final shipment preparations are conducted on the containerized wastes, and it is unlikely that releases could occur and reach the sump. The NDT Facility was completed in 1990 and operated for a brief period of time. To date, only one truck has entered the NDT Facility, and no releases of radioactive or hazardous wastes have occurred (IT Corporation 1992, 08-0021).

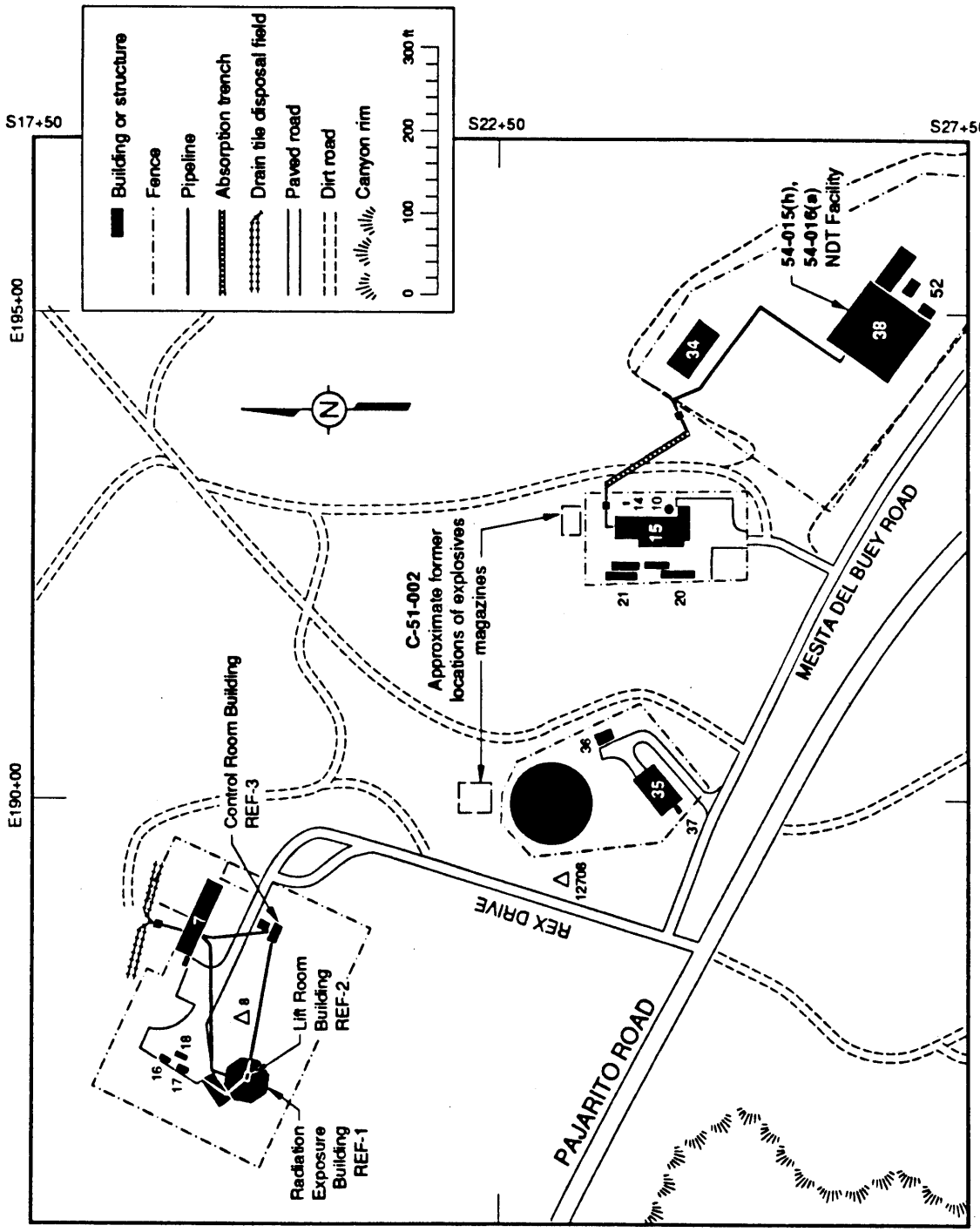


Figure 6.6-1 Location map of the western portion of TA-54, SWMUs and areas of concern recommended for no futher action (LASL 1961 [ENG C-30337]; LASL 1977 [LA-RN-A-11]; LANL 1984 [ENG-R5128]; LANL 1985 [ENG 54-47]; LANL 1990 [0145]).

Former Locations of Explosives Magazines (C-51-002)

The 1990 SWMU report listed the former locations of two explosives magazines as AOC C-51-002. The exact locations and dimensions of the magazines are unknown. The date that the structures were removed is also not known. Figure 6.6-1 presents the approximate locations for the structures as shown in the 1990 SWMU Report.

One of the structures was reportedly located north of a Laboratory water supply storage tank (TA-54-1006); the other was reportedly located north of the former Animal Holding Facility (TA-54-15). A site visit on April 16, 1992, to the area where the explosives magazines were located (Weston 1992, 08-0046) determined that there is no physical evidence of the former location of either magazine. The reported areas where the magazines were located are presently within the area of construction of the new Sanitary Wastewater Consolidation System line that will service facilities in TA-51 and the western part of TA-54. The ground surface in this area has been regraded due to trenching to install the new buried sanitary line.

There is no evidence that the past storage of explosives at the magazines has resulted in release of contaminants. Sampling of the area to determine the absence or presence of contaminants is not warranted; therefore, AOC C-51-002 is recommended for NFA.

6.6.2 Rationale for NFA

Table 6.6-1 presents the SWMUs and AOC in the western part of TA-54 that are recommended for no further action.

TABLE 6.6-1
SWMUs AND AOC IN THE WESTERN PART OF TA-54 RECOMMENDED FOR NO FURTHER ACTION

SWMU or AOC	Rationale
SWMU 54-013(a) Truck washing pit	This truck washing pit was never constructed.
SWMU 54-015(h) Drum storage area	This waste management unit was constructed after November 18, 1987. No releases have occurred from this unit.
SWMU 54-016(a) A sump in the NDT Facility	This waste management unit was constructed after November 18, 1987. No releases have occurred from this unit.
AOC C-51-002 Former locations of explosives magazines	The structures have been removed; their exact locations are not known.

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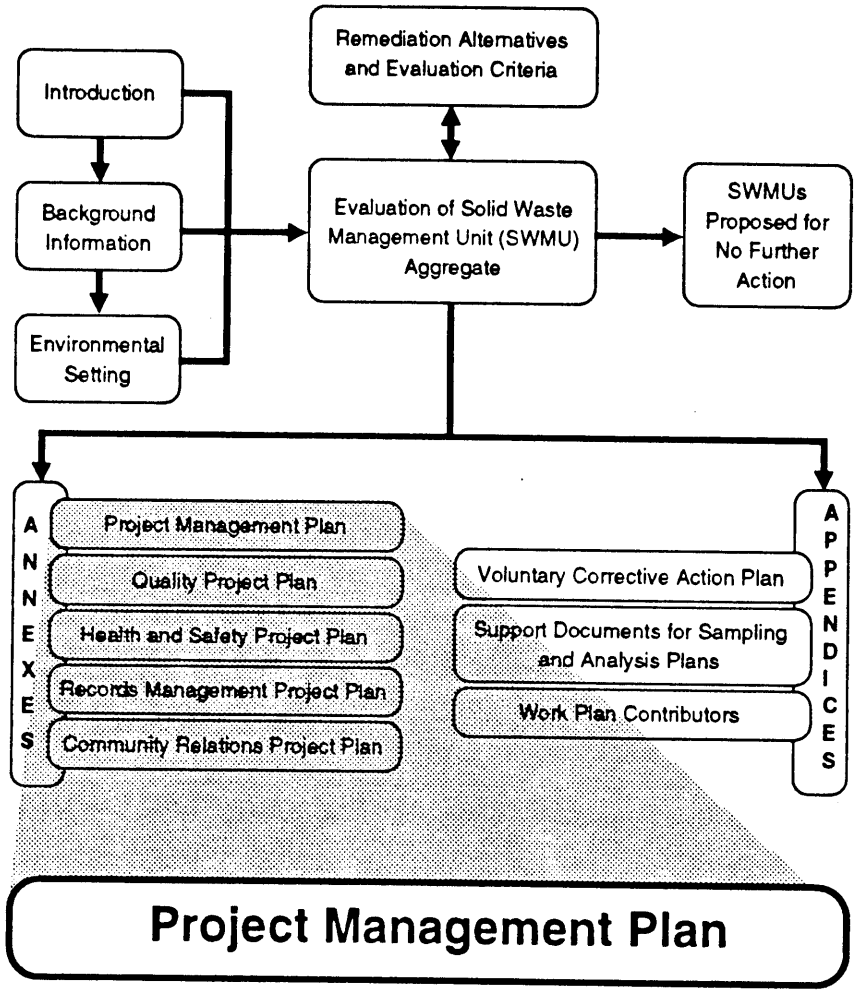
ANNEX I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ANNEX I - PROJECT MANAGEMENT PLAN

This annex presents the technical approach, schedule, reporting milestones, budget, corrective measures projections, and management structure for the implementation of the OU 1148 RFI set forth in this Work Plan. Project management for OU 1148 is an extension of the LANL ER Program Project Management Plan described in Annex I of the Installation Work Plan (LANL, 1991, 0553). Annex I in the IWP discusses the Project Management Plan requirements of the HSWA Module (Task II,E.,p. 39) of the LANL RCRA Part B Permit (EPA 1990, 0306).

1.0 Technical Approach

The technical approach for the OU 1148 RFI is described in Section 1.4 and is summarized here. The technical approach 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 ER program's technical approach includes:

- application of action levels as a trigger for Corrective Measures Study (CMS);
- a phased sampling approach to site characterization;
- decision analysis and cost effectiveness to support selection of remedial alternatives; and
- application of the observational approach to the RFI/CMS process.

This approach provides an efficient, defensible means of collecting data and generating analyses that will be used to support the CMS or a recommendation for no further action, (NFA).

The technical objectives for the OU 1148 Work Plan include:

- identification of potential contaminant migration pathways in OU 1148;
- characterization of the presence and extent of constituents of concern (COCs);
- acquisition of sufficient data to perform risk assessments; and
- provision of sufficient data to plan and perform a CMS or recommend NFA, as appropriate.

1.1 Technical Implementation Rationale

The priorities for OU 1148 field work are based on the potential health risk of the SWMU's in OU 1148 and programmatic data needs. Characterization at MDA L is scheduled first in order to gather data necessary for the Voluntary Corrective Action Plan (VCAP) to remediate the volatile organic contaminant plume present in the subsurface surrounding MDAL.

2.0 Schedule

The schedule for the entire RFI/CMS process at LANL, including OU 1148, is prescribed in the IWP Program Management Plan, (Annex I, Table I-3), and the Projected Schedule and Cost for the Corrective Action Process at Los Alamos National Laboratory (LANL 1991, 0553).

The schedule for OU 1148 RFI is summarized in Table I-1, and presented graphically in Figure I-1. This schedule is based on the FY 1992-2002 constrained baseline schedule and budget generated by the LANL ER program in spring 1992 (Attachment 1 to this annex). Changes to schedule and budget will be made through DOE change control as appropriate with revisions submitted to the Environmental Protection agency for approval.

The activities described in this schedule are contingent upon regulatory approval of this and subsequent RFI documents. The schedule is also contingent upon the availability of necessary funding, resources and contractual mechanisms at the appropriate times to complete fieldwork and comply with reporting requirements.

3.0 Reporting

The results of the OU 1148 RFI field work will be presented in five principal types of documents: Monthly Progress Reports, Quarterly Technical Progress Reports, Annual Technical Memoranda/Work Plan Modification, Phase Reports, and the RFI Report. Monthly Progress Reports will be issued by the LANL ER Program. Quarterly Technical Reports, Annual Technical Memoranda/Work Plan Modification, Phase Reports, and the RFI Report will be prepared as the OU 1148 RFI progresses.

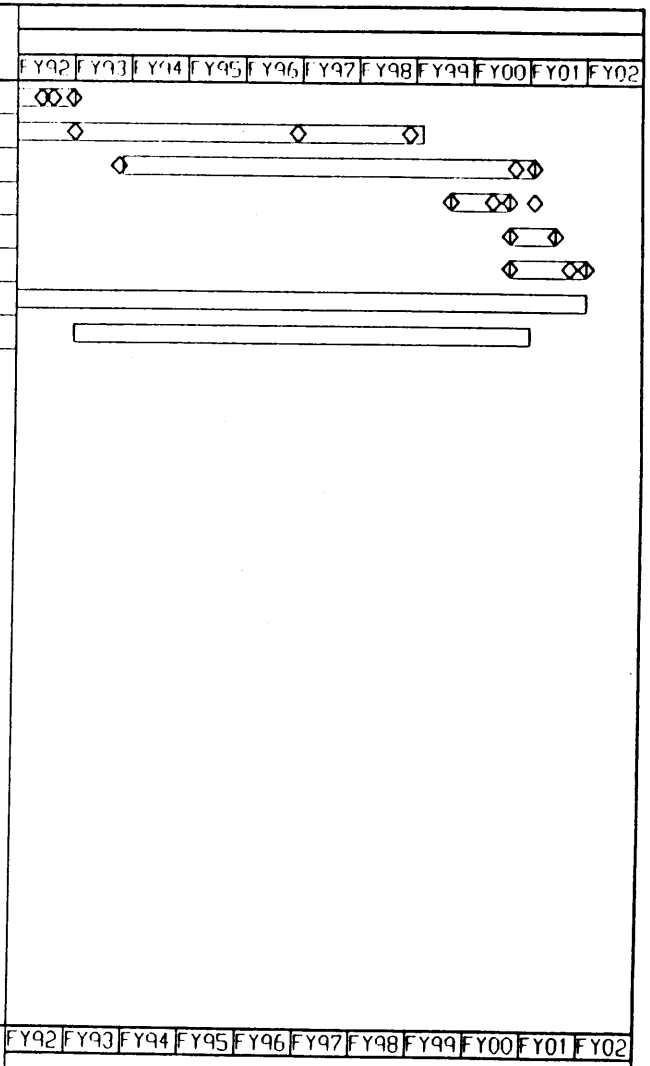
3.1 Monthly Progress Reports

Monthly progress reports will be submitted on the 25th of the following month, and will provide a summary of RFI activities. The Monthly Progress Reports will provide timely information that will allow regulatory agencies to gauge the progress of the RFI.

Table I-1 OU 1148 RFI SCHEDULE

Activity	Start Date	Finish Date
OU 1148 RFI Work Plan	1 Oct 91	30 Sep 92
OU 1148 RFI	1 Oct 91	13 Nov 98
OU 1148 RFI Report	15 Jul 93	30 Oct 00
OU 1148 CMS Plan	7 May 99	30 Oct 00
OU 1148 CMS	24 May 00	15 Mar 01
OU 1148 CMS Report	24 May 00	28 Sep 01
OU 1148 ADS Management	1 Oct 91	28 Sep 01
OU 1148 VCA	1 Oct 92	29 Sep 00

WBS4	LANL WBS 4	ORIG DUR	EARLY START	EARLY FINISH
1	ASSESSMENT - RFI WORK PLAN	250	10CT91	30SEP92
2	ASSESSMENT - RFI	1773	10CT91	13NOV98
3	ASSESSMENT - RFI REPORT	1817	15JUL93	30OCT00
4	ASSESSMENT - CMS PLAN	371	7MAY99	30OCT00
5	ASSESSMENT - CMS	200	24MAY00	15MAR01
6	ASSESSMENT - CMS REPORT	338	24MAY00	28SEP01
7	ASSESSMENT - ADS MANAGEMENT	2489	10CT91	28SEP01
8	ASSESSMENT - VCA	1991	10CT92	29SEP00



Plot Date 6MAY92
Data Date 10CT91
Project Start 10CT91
Project Finish 30SEP02 *

(c) Primavera Systems, Inc

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

LANL EM-13 B GILKESON
1148: TA-51 54 R1 TBS 3/16/92
SUMMARY BAR CHART

Sheet 1 of 1

ENVIRONMENTAL RESTORATION

Date	Revision	Checked	Approved

Figure I-1 Summary of schedule for OU 1148 RCRA Facility Investigation.

3.2 Quarterly Technical Progress Reports

The progress of the OU 1148 RFI will be summarized in Quarterly Technical Progress Reports, as required in the LANL Part B operating permit (Task V, C, p. 46). Quarterly Technical Reports will be issued on 15 February, 15 May, and 15 August of each year during the RFI, upon approval of this work plan. The Quarterly Technical Reports will be used to provide timely information that will allow regulatory agencies sufficient information to gauge the progress of the RFI.

3.3 Annual Technical Memoranda/Work Plan Modification

Annual Technical Memoranda/Work Plan Modification will be completed at the end of each fiscal year to provide a regular technical update of RFI progress and to modify upcoming field work where necessary. They will provide a more detailed summary of data and analysis generated during the RFI than the Monthly Progress Reports or the Quarterly Technical Progress Reports. The Annual Technical Memoranda/ Work Plan Modification will also contain work plans for additional characterization for SWMU's in OU 1148 when necessary.

Table I-2 describes the outline for Annual Technical Memoranda/Work Plan Modifications and Phase Reports.

3.4 Phase Reports

Reports summarizing the results of the first and second phases of the OU 1148 RFI investigations will be prepared at the conclusion of each phase of work. The Phase I report will present the results of the phase I investigation and any modifications to plans for the second phase of the RFI. The Phase II report will present the results of the second phase of the RFI.

3.5 RFI Report

The RFI Report will summarize the field work conducted during the RFI investigations described in this Work Plan. The RFI Report will describe the procedures, methods, and results of field investigations, and will include information on the type and extent of contamination, sources and migration pathways, and actual and potential receptors. The report will also contain sufficient information to support delisting of sites that require NFA or to recommend a CMS.

TABLE I-2 OUTLINE OF ANNUAL TECHNICAL MEMORANDA AND PHASE REPORTS

1. Executive Summary
2. Introduction
3. SWMU Descriptions
4. Summary of Investigations
5. Methods and Procedures
   - 5.1 Data Quality Summary
   - 5.2 Source Term
   - 5.3 Nature and Extent of Contamination
   - 5.4 Contaminant Migration
6. Subsequent Investigations
7. Work Plan and Permit Modifications

4.0 Budget

The schedule presented above is dependent on the budgetary figures listed in Table I-3. This budget is based on the FY 1992-2002 constrained baseline schedule and budget generated by the LANL ER program in spring 1992 (Attachment 1 to this annex). Changes to schedule and budget for the OU 1148 RFI will be made through DOE change control as appropriate, with revisions submitted to the Environmental Protection Agency for approval.

5.0 Corrective Measures

The schedule for OU 1148 given in Table I-2 estimates the delivery of the CMS Plan to the EPA in October 2000.

Discussion of the CMS at this time is limited because of the lack of data presently available for many of the SWMU's in OU 1148. Following initial investigation and data analysis, SWMU's for which there is no evidence for significant contaminant release will be proposed for NFA.

Corrective measures will be proposed for SWMU's if the RFI characterization described in this Work Plan indicate that a significant contaminant release may have occurred.

5.1 Estimated Number of SWMU's in Corrective Measures Study

It is difficult to predict the number of SWMU's that will be considered in the CMS before the RFI data has been collected. Based on present data, the CMS may include the 34 SWMU's listed in Table I-4.

5.2 Interim Remedial Measures

A voluntary corrective action plan to remediate the volatile organic contaminant plume at MDA L is described in Appendix A, Voluntary Corrective Action Plan.

6.0 OU 1148 Organization and Responsibility

The organizational and management structure for the LANL ER Program detailed to the level of OU Project and Technical Team Leaders, is described in section 2.0 of the LANL ER Program Quality Program Plan (QPP) (LANL 1991, 0553). This section details the management and field investigation team organization for the OU 1148 RFI. Figure I-2 shows the organizational structure of the OU 1148 field investigation team. The positions and their major responsibilities are listed below.

TABLE I-3 OU 1148 RFI PROJECTED BUDGET (In Thousands of Dollars)

Activity	Cost
RFI Work Plan	$1,108
RFI	45,811
RFI Report	1,816
CMS Plan	79
CMS	1,168
CMS Report	303
ADS Management	1,863
VCA	3,340
Subtotal	55,488
Undistributed Escalation (98-02)	1,420
Prior Years	1,736
TOTAL at Completion	58,644

TABLE I-4 OU 1148 SWMUS THAT MAY BE INCLUDED IN CORRECTIVE MEASURES STUDY

SWMU No./Location	SWMU Description
MDA L	
54-001(a,b,e)[1]	Hazardous Waste Container Storage Areas
54-001(d)[1]	PCB Storage Building
54-002[1]	Compressed Gas Storage Area
54-006[2]	Material Disposal Area L (pits, impoundments and disposal shafts)
54-009[1]	Treatment Tanks
54-012(b)	Drum compactor
54-014(a)	Radioactive Waste Storage Shafts
AOC[3]	Former location of six waste oil storage tanks
MDA G	
54-007(a)	Septic System
54-012(a)	Compactor
54-013(b)	Truck Washing Pit
54-014(b,c,d)	Radioactive Waste Storage Shafts and Pits
54-015(a,b,c,d,e,f,j,k)	Surface Storage of Radioactive Waste
54-016(b)	Sump
54-017	Disposal Pits Active before 11/19/1980
54-018	Disposal Pits Active after 11/19/1980
54-019	Disposal Shafts Active before 11/19/1980
54-020	Disposal Shafts Active after 11/19/1980
MDA H	
54-004[4]	Material Disposal Area H
MDA J	
54-005	Material Disposal Area J
Other Facilities	
51-001	Septic Systems
54-007(c-e)	Septic System

1 The CMS will include closure plan modifications for these SWMUs under authority of New Mexico Environmental Division (NMED).

2 The CMS will include closure plan modification for surface impoundments B, C, and D, and disposal shafts 1, 14-34 under authority of NMED.

3 The tanks were removed from MDA L and stored at MDA G as SWMU 54-021. A NMED closure plan has been submitted for the tanks. However the CMS will include closure plan modification under authority of NMED for the former location of the tanks.

4 The CMS will include closure plan modification for disposal shaft 9 under authority of NMED.

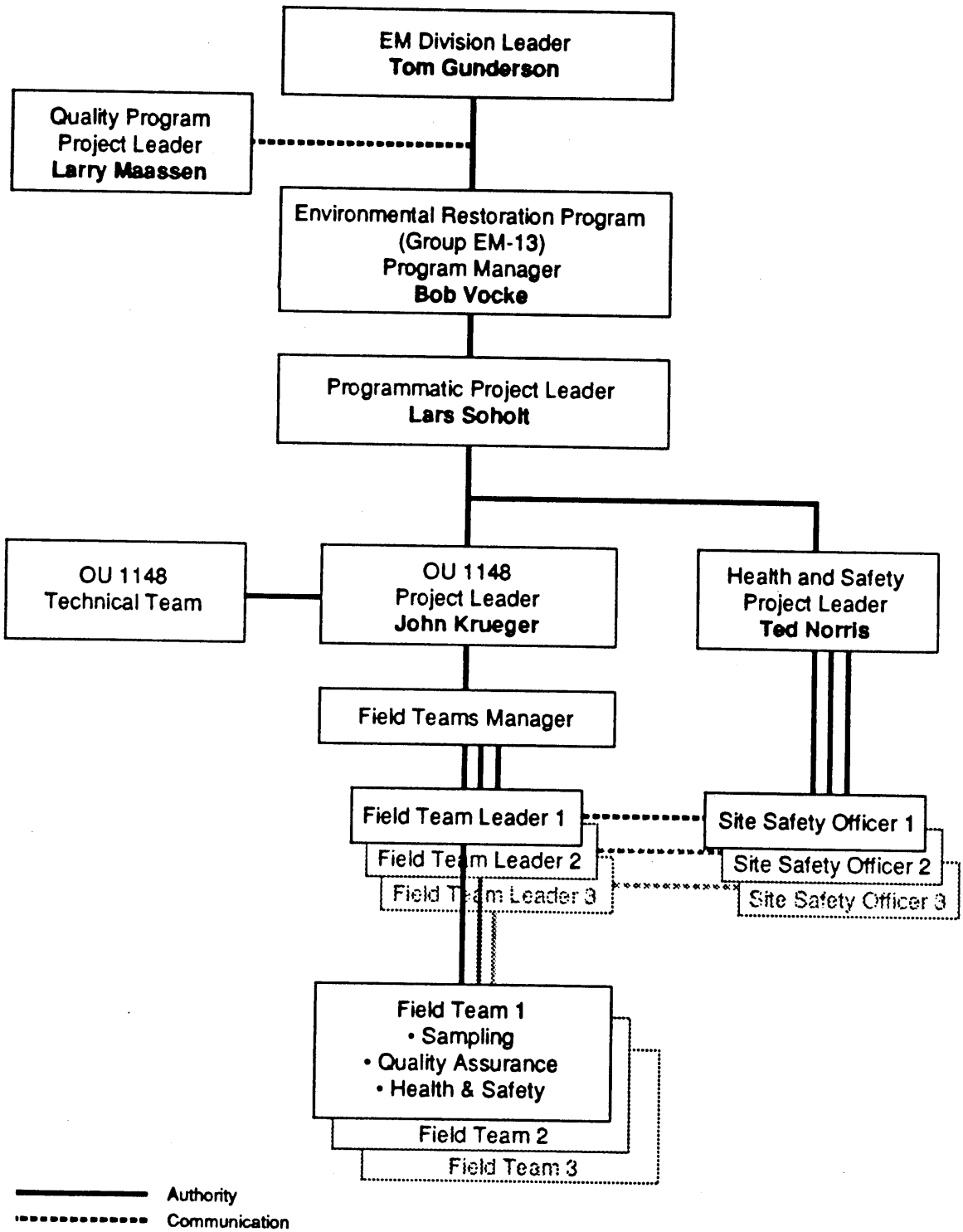


Figure I-2 Operable Unit 1148 field work organization chart.

6.1 OU 1148 Project Leader

The responsibilities of the OU 1148 Project Leader include oversight of OU 1148 RFI operations, including preparation of this Work Plan, field work, reporting, and RFI-related administrative activities. The OU 1148 Project Leader will oversee the preparation of reports, supervise LANL staff and contractors assigned to OU 1148, coordinate with Technical Team Leaders, and provide technical oversight for the RFI process. The OU 1148 Project Leader ensures compliance with appropriate ER, LANL, state and federal regulatory policies and procedures, including the LANL ER health and safety, records management, and community relations requirements. John Krueger, EM-13, is the OU 1148 Project Leader.

6.2 Technical Team Members

Technical team members are responsible for providing technical input for their discipline throughout the RFI/CMS process. During the OU 1148 RFI, they have participated in the development of this work plan, and will participate in the fieldwork, data analysis, report preparation, work plan modifications, and planning of subsequent investigations as necessary.

6.3 OU 1148 Field Teams Manager, Field Team Leaders

The OU 1148 Field Teams Manager schedules and plans OU 1148 RFI field work, and oversees field investigations for OU 1148. Field Team Leaders will direct the execution of field activities under the supervision of the Field Teams Manager. The Field Teams Manager and the Field Team Leaders will be assigned as the RFI progresses.

6.4 Field Team Members

The field teams will consist of members representing numerous disciplines as called for by the nature and extent of a given field investigation. Field team members may include sampling personnel, geologists, geomorphologists, and health physicists. All field teams will include a site safety officer. Field teams are responsible for conducting OU 1148 field work under the direction of the Field Team Leader.

Attachment I-1
FY 1992-2002 Baseline Schedule and
Budget for OU 1148 RFI (Spring 1992 Version)

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
280090	63	63	0	1148: Sect 8: QA Project Plan	RFI WP		1OCT91	6JAN92
					99081.00	.00		
280095	63	63	0	1148: Sect 9: Health & Safety Plan	RFI WP		1OCT91	6JAN92
					99081.00	.00		
280100	63	63	0	1148: Sect10: Records Mgt Plan	RFI WP		1OCT91	6JAN92
					82000.00	.00		
280105	18	18	0	1148: Sect11: Comm Relations Plan	RFI WP		9DEC91	6JAN92
					4033.00	.00		
280160	250	250	0	1148: Cond Bench/Pilot Studies	RFI WP (LOE)		1OCT91	30SEP92
					.00	.00		
280165	250	250	0	1148: Cond VCA -	RFI WP (LOE)		1OCT91	30SEP92
					164053.00	.00		
280175	250	250	0	1148: Manage ADS FY-92	(LOE)		1OCT91	30SEP92
					286234.00	.00		
280180	250	250	0	1148: Develop NEPA Documentation	RFI WP		1OCT91	30SEP92
					31807.00	.00		
280190	249	249	0	1148: Manage ADS FY-93	(LOE)		1OCT92	30SEP93
					149653.00	.00		
280200	249	249	0	1148: Manage ADS FY-94	(LOE)		1OCT93	30SEP94
					157887.00	.00		
280210	248	248	0	1148: Manage ADS FY-95	(LOE)		3OCT94	29SEP95
					166567.00	.00		
280230	249	249	0	1148: Manage ADS FY-96	(LOE)		2OCT95	30SEP96
					175733.00	.00		
280240	249	249	0	1148: Manage ADS FY-97	(LOE)		1OCT96	30SEP97
					185395.00	.00		
280250	249	249	0	1148: Manage ADS FY-98	(LOE)		1OCT97	30SEP98
					185395.00	.00		
280270	249	249	0	1148: Manage ADS FY-99	(LOE)		1OCT98	30SEP99
					185395.00	.00		
280271	249	249	0	1148: Manage ADS FY-00	(LOE)		1OCT99	29SEP00
					185395.00	.00		

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
280272	248	248	0	1148: Manage ADS FY-01		(LOE)	2OCT00	28SEP01
					185395.00	.00		
280275	18	18	0	1148: Develop Internal Draft	RFI WP		9DEC91*	6JAN92
					49022.00	.00		
280285	19	19	0	1148: DOE/LANL/VE Rev Internal Dft	RFI WP		7JAN92	3FEB92
					5014.00	.00		
280295	10	10	0	1148: Inc DOE/LANL Comment Int Dft	RFI WP		4FEB92	18FEB92
					61039.00	.00		
280305	10	10	0	1148: Issue DOE Draft	RFI WP		19FEB92	3MAR92
					36021.00	.00		
280310	22	22	0	1148: DOE Review DOE Draft	RFI WP		4MAR92	2APR92
					6104.00	.00		
280315	20	20	0	1148: Inc DOE Comments DOE Draft	RFI WP		3APR92	30APR92
					107861.00	.00		
280320	10	10	0	1148: Issue EPA/NMED Draft	RFI WP		1MAY92	14MAY92
					45958.00	.00		
280325	44	44	0	1148: NMED Review	RFI WP		15MAY92	17JUL92
					6976.00	.00		
280330	44	44	0	1148: EPA Review	RFI WP		15MAY92	17JUL92
					6976.00	.00		
280340	249	249	0	1148: RFI Bench/Pilot Studies		(LOE)	1OCT92	30SEP93
					.00	.00		
280345	55	55	0	1148: Field Work FY-93	RFI PH1		15JUL93*	30SEP93
					314592.00	.00		
280346	249	249	0	1148: Field Work FY-94	RFI PH1		1OCT93*	30SEP94
					789351.00	.00		
280347	248	248	0	1148: Field Work FY-95	RFI PH1		30CT94*	29SEP95
					801776.00	.00		
280350	55	55	0	1148: Sample Analysis FY-93	RFI PH1		15JUL93	30SEP93
					2686350.00	.00		
280351	249	249	0	1148: Sample Analysis FY-94	RFI PH1		1OCT93	30SEP94
					3002509.00	.00		

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
280352	248	248	0	1148: Sample Analysis FY-95	RFI PH1		30CT94	29SEP95
					4053163.00	.00		
280353	100	100	0	1148: Sample Analysis FY-96	RFI PH1		20CT95	29FEB96
					7690902.00	.00		
280355	55	55	0	1148: Data Assessment FY-93	RFI PH1		15JUL93	30SEP93
					20483.00	.00		
280356	249	249	0	1148: Data Assessment FY-94	RFI PH1		1OCT93	30SEP94
					62650.00	.00		
280357	248	248	0	1148: Data Assessment FY-95	RFI PH1		30CT94	29SEP95
					33489.00	.00		
280358	125	125	0	1148: Data Assessment FY-96	RFI PH1		20CT95	4APR96
					34029.00	.00		
280360	60	60	0	1148: Write Report /WP Modification	RFI PH1		5APR96	28JUN96
					100559.00	.00		
280365	20	20	0	1148: Demobilize Field Work	RFI PH1		20CT95	30OCT95
					9207.00	.00		
280370	22	22	0	1148: EPA/NMED Review RPT / WP Mod	RFI PH1		29AUG96	30SEP96
					12652.00	.00		
280372	20	20	0	1148: Inc EPA/NMED Comments RPT/WP	RFI PH1		1OCT96	29OCT96
					.00	.00		
280374	10	10	0	1148: Issue Final Report/WP Mod	RFI PH1		30OCT96	13NOV96
					.00	.00		
280375	22	22	0	1148: DOE Review RPT / WP Mod	RFI PH1		1JUL96	31JUL96
					12652.00	.00		
280377	20	20	0	1148: Inc DOE/LANL Comments RPT/WP	RFI PH1		1AUG96	28AUG96
					.00	.00		
280380	20	20	0	1148: Write Contract and Mobilize	RFI PH2		1AUG96*	28AUG96
					39657.00	.00		
280385	22	22	0	1148: Field Work FY-96	RFI PH2		29AUG96	30SEP96
					143695.00	.00		
280386	249	249	0	1148: Field Work FY-97	RFI PH2		1OCT96	30SEP97
					1124786.00	.00		

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
280387	200	200	0	1148: Field Work FY-98	RFI PH2		1OCT97	22JUL98
					1124786.00	.00		
280390	22	22	0	1148: Sample Analysis FY-96	RFI PH2		29AUG96	30SEP96
					693523.00	.00		
280391	249	249	0	1148: Sample Analysis FY-97	RFI PH2		1OCT96	30SEP97
					10099473.00	.00		
280392	249	249	0	1148: Sample Analysis FY-98	RFI PH2		1OCT97	30SEP98
					8068957.00	.00		
280393	20	20	0	1148: Sample Analysis FY-99	RFI PH2		1OCT98	29OCT98
					2144763.00	.00		
280395	20	20	0	1148: Demobilize Field Work	RFI PH2		23JUL98	19AUG98
					9207.00	.00		
280400	100	100	0	1148: Facility Investigation	RFI RPT		16NOV98	13APR99
					153736.00	.00		
280405	110	110	0	1148: Investigation Analysis	RFI RPT		16NOV98	27APR99
					631787.00	.00		
280410	22	22	0	1148: Data Assessment FY-96	RFI PH2		29AUG96	30SEP96
					12810.00	.00		
280411	249	249	0	1148: Data Assessment FY-97	RFI PH2		1OCT96	30SEP97
					119948.00	.00		
280412	249	249	0	1148: Data Assessment FY-98	RFI PH2		1OCT97	30SEP98
					111005.00	.00		
280413	30	30	0	1148: Data Assessment FY-99	RFI PH2		1OCT98	13NOV98
					7946.00	.00		
280415	100	100	0	1148: Develop NEPA Documentation	RFI RPT		10AUG93*	6JAN94
					93890.00	.00		
280425	132	132	0	1148: Prepare Internal Draft	RFI RPT		28APR99	3NOV99
					655170.00	.00		
280435	20	20	0	1148: DOE/LANL/VE Rev Internal Dft	RFI RPT		4NOV99	6DEC99
					26127.00	.00		
280445	40	40	0	1148: Inc DOE/LANL Comments Int Dft	RFI RPT		7DEC99	4FEB00
					25075.00	.00		

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
280450	20	20	0	1148: Issue DOE Draft	RFI RPT		7FEB00	6MAR00
					87725.00	.00		
280455	22	22	0	1148: DOE Review DOE Draft	RFI RPT		7MAR00	5APR00
					11127.00	.00		
280460	40	40	0	1148: Inc DOE Comments DOE Draft	RFI RPT		6APR00	1JUN00
					11127.00	.00		
280465	20	20	0	1148: Issue EPA/NMED Draft	RFI RPT		2JUN00	29JUN00
					92184.00	.00		
280470	44	44	0	1148: EPA Review	RFI RPT		30JUN00	31AUG00
					11736.00	.00		
280475	44	44	0	1148: NMED Review	RFI RPT		30JUN00	31AUG00
					11736.00	.00		
280480	245	245	0	1148: CMS Bench/Pilot Studies	CMS PLN		7MAY99	1MAY00
					.00	.00		
280485	35	35	0	1148: Establish Current Situation	CMS PLN		7MAY99	25JUN99
					5595.00	.00		
280490	35	35	0	1148: Establish CA Objectives	CMS PLN		7MAY99	25JUN99
					8763.00	.00		
280495	35	35	0	1148: Develop Screening Technology	CMS PLN		7MAY99	25JUN99
					7977.00	.00		
280500	245	245	0	1148: Develop NEPA Documentation	CMS PLN		7MAY99	1MAY00
					4970.00	.00		
280505	35	35	0	1148: Develop Alternatives	CMS PLN		28JUN99	16AUG99
					7977.00	.00		
280510	35	35	0	1148: Develop Internal Draft	CMS PLN		17AUG99	5OCT99
					3999.00	.00		
280515	10	10	0	1148: DOE/LANL/VE Review Int Draft	CMS PLN		6OCT99	20OCT99
					589.00	.00		
280520	10	10	0	1148: Inc DOE/LANL Comments Int Dft	CMS PLN		21OCT99	3NOV99
					589.00	.00		
280525	5	5	0	1148: Issue DOE Draft	CMS PLN		4NOV99	10NOV99
					1988.00	.00		

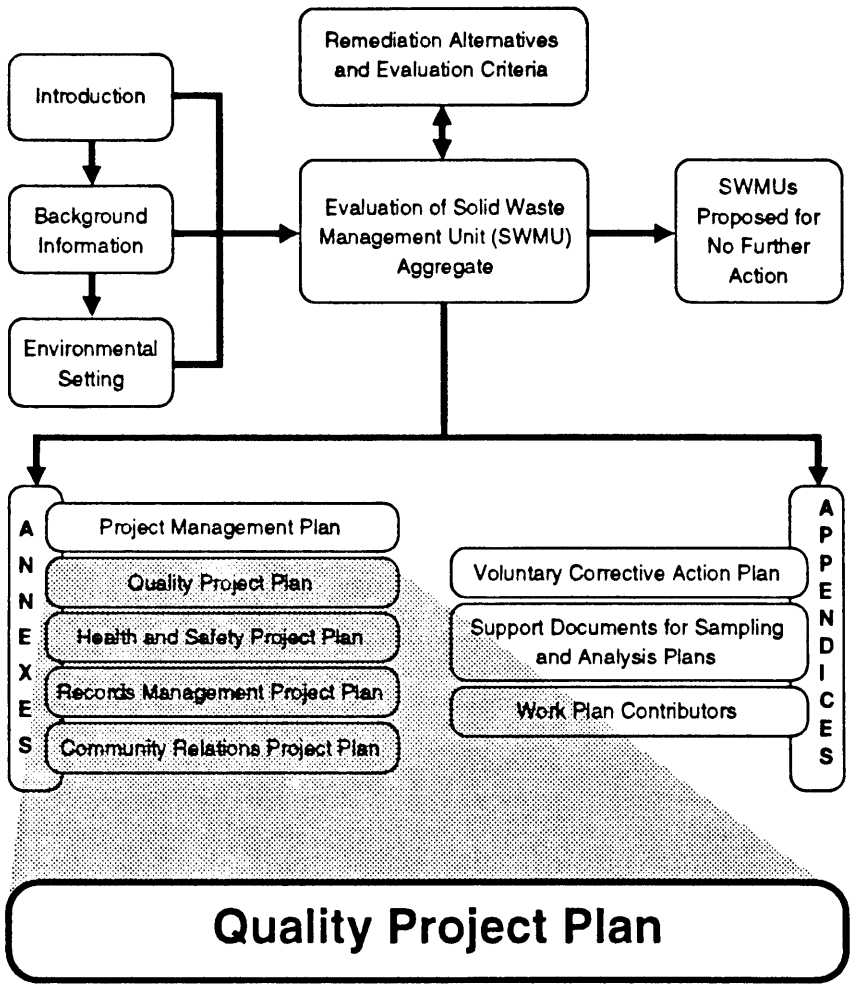
ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
280530	22	22	0	1148: DOE Review DOE Draft		CMS PLN	11NOV99	15DEC99
					.00	.00		
280535	20	20	0	1148: Inc DOE Comments DOE Draft		CMS PLN	16DEC99	18JAN00
					.00	.00		
280540	10	10	0	1148: Issue EPA/NMED Draft		CMS PLN	19JAN00	1FEB00
					1528.00	.00		
280545	44	44	0	1148: EPA Review		CMS PLN	2FEB00	4APR00
					.00	.00		
280550	44	44	0	1148: NMED Review		CMS PLN	2FEB00	4APR00
					.00	.00		
280555	200	200	0	1148: CMS Bench/Pilot Studies		(LOE)	24MAY00	15MAR01
					1167795.00	.00		
280560	1	1	0	1148: Technical Evaluation		CMS RPT	24MAY00	24MAY00
					41082.00	.00		
280565	30	30	0	1148: Environmental Evaluaion		CMS RPT	24MAY00	6JUL00
					40414.00	.00		
280570	30	30	0	1148: Human Health Evaluation		CMS RPT	24MAY00	6JUL00
					38784.00	.00		
280575	30	30	0	1148: Community Relations Eval		CMS RPT	24MAY00	6JUL00
					35677.00	.00		
280580	30	30	0	1148: Cost Evaluation		CMS RPT	24MAY00	6JUL00
					37579.00	.00		
280585	30	30	0	1148: Develop NEPA Documentation		CMS RPT	24MAY00	6JUL00
					73659.00	.00		
280590	10	10	0	1148: Prepare Internal Draft		CMS RPT	7JUL00	20JUL00
					12907.00	.00		
280595	10	10	0	1148: DOE/LANL/VE Rev Internal Drft		CMS RPT	21JUL00	3AUG00
					1363.00	.00		
280600	35	35	0	1148: Inc DOE/LANL Comments Int Dft		CMS RPT	25JAN01	15MAR01
					1363.00	.00		
280605	22	22	0	1148: Issue DOE Draft		CMS RPT	16MAR01	16APR01
					6393.00	.00		

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
280610	22	22	0	1148: DOE Review DOE Draft	CMS RPT		17APR01	16MAY01
					888.00	.00		
280615	10	10	0	1148: Inc DOE Comments DOE Draft	CMS RPT		17MAY01	31MAY01
					888.00	.00		
280620	10	10	0	1148: Issue EPA/NMED Draft	CMS RPT		1JUN01	14JUN01
					5004.00	.00		
280625	44	44	0	1148: EPA Review	CMS RPT		15JUN01	16AUG01
					888.00	.00		
280630	44	44	0	1148: NMED Review	CMS RPT		15JUN01	16AUG01
					888.00	.00		
280635	249	249	0	1148: Conduct VCA -		(LOE)	1OCT92*	30SEP93
					.00	.00		
280640	60	60	0	1148: Write Contracts and Mobilize	RFI PH1		1OCT92*	31DEC92
					67846.00	.00		
280645	20	20	0	1148: Inc EPA/NMED Comments	RFI WP		20JUL92	14AUG92
					16985.00	.00		
280650	28	28	0	1148: Issue Final	RFI WP		17AUG92	24SEP92
					14003.00	.00		
280670	20	20	0	1148: Inc EPA/NMED Comments	RFI RPT		1SEP00	29SEP00
					3447.00	.00		
280675	20	20	0	1148: Issue Final	RFI RPT		2OCT00	30OCT00
					1242.00	.00		
280680	20	20	0	1148: Inc EPA/NMED Comments	CMS PLN		5APR00	2MAY00
					.00	.00		
280685	10	10	0	1148: Issue Final	CMS PLN		3MAY00	16MAY00
					30907.00	.00		
280690	5	5	0	1148: EPA Approval	CMS PLN		17MAY00	23MAY00
					3808.00	.00		
280695	20	20	0	1148: Inc EPA/NMED Comments	CMS RPT		17AUG01	14SEP01
					1515.00	.00		
280700	10	10	0	1148: Issue Final	CMS RPT		17SEP01	28SEP01
					3808.00	.00		

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
280705	250	250	0	1148: MDA G Pilot Studies FY-92		(LOE)	1OCT91*	30SEP92
					295110.00	.00		
280710	249	249	0	1148: MDA G Pilot Studies FY-93		(LOE)	1OCT92	30SEP93
					311341.00	.00		
280715	249	249	0	1148: MDA G Pilot Studies FY-94		(LOE)	1OCT93	30SEP94
					328453.00	.00		
280720	248	248	0	1148: MDA G Pilot Studies FY-95		(LOE)	3OCT94	29SEP95
					346516.00	.00		
280725	249	249	0	1148: MDA G Pilot Studies FY-96		(LOE)	2OCT95	30SEP96
					365580.00	.00		
280730	249	249	0	1148: MDA G Pilot Studies FY-97		(LOE)	1OCT96	30SEP97
					385692.00	.00		
280735	249	249	0	1148: MDA G Pilot Studies FY-98		(LOE)	1OCT97	30SEP98
					385692.00	.00		
280740	63	63	0	1148: Determine Data Needs	RFI WP		1OCT91	6JAN92
					56018.00	.00		
280745	63	63	0	1148: Develop Sampling Plans	RFI WP		1OCT91	6JAN92
					175616.00	.00		
280750	86	86	0	1148: Write Management Plan	RFI WP		3ODEC91	30APR92
					40003.00	.00		
280755	249	249	0	1148: Conduct VCA RFI FY-93		(LOE)	1OCT92*	30SEP93
					.00	.00		
280760	248	248	0	1148: Conduct VCA RFI FY-95		(LOE)	3OCT94*	29SEP95
					3140489.00	.00		
280765	249	249	0	1148: Conduct VCA RFI FY-96		(LOE)	2OCT95	30SEP96
					.00	.00		
280770	249	249	0	1148: Conduct VCA RFI FY-97		(LOE)	1OCT96	30SEP97
					.00	.00		
280775	249	249	0	1148: Conduct VCA RFI FY-98		(LOE)	1OCT97	30SEP98
					.00	.00		
280780	249	249	0	1148: Conduct VCA RFI FY-99		(LOE)	1OCT98	30SEP99
					.00	.00		

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
280785	249	249	0	1148: Conduct VCA RFI FY-00		(LOE)	10CT99	29SEP00
					.00	.00		
710000	189	189	0	2114: Conduct VCA - Remediation		(LOE)	2JAN97*	30SEP97
					84706.00	.00		
710005	249	249	0	2114: Conduct VCA - Remediation		(LOE)	10CT97	30SEP98
					114959.00	.00		
28M010	0	0	0	1148: DOE DRAFT RFI WORK PLAN COMPLETED				3MAR92
					.00	.00		
28M015	0	0	0	1148: EPA/NMED DRAFT OF RFI WORK PLAN COMPLETED				14MAY92
					.00	.00		
28M020	0	0	0	1148: RFI WORK PLAN COMPLETED				24SEP92
					.00	.00		
28M025	0	0	0	1148: START RFI				10CT92*
					.00	.00		
28M030	0	0	0	1148: RFI FIELD WORK COMPLETED				19AUG98
					.00	.00		
28M035	0	0	0	1148: START DEVELOPING RFI REPORT			15JUL93	
					.00	.00		
28M040	0	0	0	1148: EPA/NMED DRAFT OF RFI REPORT COMPLETED				29JUN00
					.00	.00		
28M045	0	0	0	1148: RFI COMPLETED				30OCT00
					.00	.00		
28M050	0	0	0	1148: START DEVELOPMENT OF CMS PLAN			7MAY99	
					.00	.00		
28M055	0	0	0	1148: EPA/NMED DRAFT OF CMS PLAN COMPLETED				1FEB00
					.00	.00		
28M060	0	0	0	1148: START CMS WORK			24MAY00	
					.00	.00		
28M065	0	0	0	1148: CMS WORK COMPLETED				15MAR01
					.00	.00		
28M070	0	0	0	1148: START DEVELOPMENT OF CMS REPORT			24MAY00	
					.00	.00		

ANNEX II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1.0 APPROVAL FOR IMPLEMENTATION

1. NAME: Robert Vocke
   TITLE: ER Program Manager (EM-13), Los Alamos National Laboratory

Signature:_____ Date:_____

2. NAME: Karen Foster
   TITLE: Quality Assurance Project Leader, ER Program (EM-13), Los Alamos National Laboratory

Signature:_____ Date:_____

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

Signature:_____ Date:_____

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

Signature:_____ Date:_____

5. NAME: John Krueger
   TITLE: Project Leader, ER Program (EM-13), Los Alamos National Laboratory

Signature:_____ Date:_____

6. NAME: Charles Ritchey
   TITLE: Acting Chief of Office of Quality Assurance, Region VI, Environmental Protection Agency

Signature:_____ Date:_____

2.0 LIST OF ACRONYMS

AP	-	Administrative Procedure
ASA	-	American Society of Agronomy, Inc.
ASTM	-	American Society for Testing Materials
COE	-	U.S. Army Corps of Engineers
DOE	-	U.S. Department of Energy
DQO	-	Data Quality Objective
EM	-	Environmental Management
EPA	-	U.S. Environmental Protection Agency
ER	-	Environmental Restoration
FIMAD	-	Facility for Information Management, Analysis and Display
H&S	-	Health and Safety
HSE	-	Health, Safety and Environment Division
ICPMS	-	Inductively Coupled Plasma Mass Spectroscopy
IWP	-	Installation Work Plan
LANL	-	Los Alamos National Laboratory
OU	-	Operable Unit
PARCC		Precision, Accuracy, Representativeness, Completeness, and Comparability
PCB	-	Polychlorinated biphenyl
PL	-	Project Leader
PM	-	Program Manager
QA	-	Quality Assurance
QAP	-	Quality Assurance Plan
QAPjP	-	Quality Assurance Project Plan
QA/QC	-	Quality Assurance/Quality Control
QC	-	Quality Control
QP	-	Quality Procedure
QPP	-	Quality Program Plan
QPPL	-	Quality Program Project Leader
RCRA	-	Resource Conservation and Recovery Act
RFI	-	RCRA Facility Investigation
RMP	-	Records Management Plan
SMF	-	Sample Management Facility
SOP	-	Standard Operating Procedure
SSSA	-	Soil Science Society of America, Inc.
SW	-	Solid Waste
SWMU	-	Solid Waste Management Unit
USATHAMA	-	U.S. Army Toxic and Hazardous Materials Agency

3.0 PROJECT DESCRIPTION

3.1 Introduction

This Operable Unit (OU) 1148 Resrouce, Conservation and Recovery Act (RCRA) Facility Investigation Quality Assurance (QA) Project Plan is specific to the Los Alamos National Laboratory's (the Laboratory's) Environmental Restoration (ER) Program. Information that is covered in the Laboratory's Environmental Restoration Program Generic Quality Assurance Project Plan (QAPjP) (LANL 1991, 0412), the Installation Work Plan (IWP) (LANL 1991, 0553), or elsewhere, is cited as necessary.

This OU 1148 Quality Assurance Project Plan includes the Environmental Protection Agency's (EPA) guidance on preparing quality assurance plans (EPA 1980, 0552), and the American Society of Mechanical Engineers' (ASME) "Quality Assurance Program Requirements for Nuclear Facilities" (ANSI/ASME 1989, 0018) as specified in Department of Energy (DOE) Order 5700.6B (DOE 1986, 0067). The integration is described in the Quality Assurance Program, Section 3.0 of the Laboratory's Environmental Restoration (ER) Quality Program Plan, which was published as Annex II of the Laboratory's (IWP) (LANL 1991, 0553).

A general description of the OU 1148 RFI tasks is presented in Chapter 2.0 of this work plan.

3.2 Facility Description

A facility description of the Laboratory is presented in Section 2.0 of the IWP (LANL 1991, 0533). A description of and historical information on OU 1148 is presented in Sections 2.0 and 3.0 of this work plan.

3.3 Environmental Restoration Program

A description of the Laboratory's ER Program is presented in Section 3.0 of the IWP (LANL 1991, 0553).

3.4 Project Description

3.4.1 Project Objectives

The project objectives are outlined in Section 1.0 of this work plan.

3.4.2 Project Schedule

Project activity dates are presented in Annex I of this work plan.

3.4.3 Project Scope

This information is presented in Section 1.0 of this work plan.

3.4.4 Background Information

This information is presented in Section 1.0 of this work plan.

3.4.5 Records Management

Information regarding data management is presented in Annex IV of this work plan. Data collected during the RFI will be used to determine the nature and extent of contamination at solid waste management unit (SWMU) aggregates, as detailed in the Field Sampling Plans in Section 5.0 of this work plan. Data collected during the RFI will be input into the Facility for Information Management, Analysis and Display (FIMAD) following the ER Records Management Procedure AP-02.1. It will be analyzed, as appropriate, using statistical techniques, kriging, 2- and 3-dimensional modeling, or other appropriate methods (refer to IWP Annex IV [LANL 1991, 0553] and IWP updates for additional details of FIMAD developments).

4.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The overall organizational structure of the ER Program is presented in Section 2.0 of the IWP Annex II (LANL 1991, 0553). ER Program personnel are identified in the plan, and responsibilities and line authority are detailed. The QA organizational structure is shown, and personnel qualifications are also described in Appendix R.

Records of the qualifications and training of all personnel working on the OU 1148 RFI field work will be kept as part of the OU 1148 RFI work plan records (see Records Management Plan, Annex IV of this work plan).

Personnel Quality Assurance responsibilities follow.

OU 1148 Project Leader (OUPL)

- The OUPL responsibilities are listed in Annex II of the IWP (LANL, 1991, 0553).

OU 1148 Quality Program Project Leader (QPPL)

- The QPPL responsibilities are listed in Annex II of the IWP.

OU 1148 Field Teams Leader

- The field teams leader oversees the day-to-day field operations, including planning, scheduling and implementation of RFI field activities detailed in Section 5.0 of this Work Plan; and

- The field team leader also manages field team members.

Field Team Member(s)

Field team members include, depending upon the sampling activity being conducted, sampling personnel, a site safety officer, and staff members with technical knowledge of geology, hydrology, statistics, or other applicable disciplines.

The responsibilities of the quality program project leader, the QA representative and other QA staff are given in Section 2 of Annex II of the IWP (LANL 1991, 0553).

5.0 QUALITY ASSURANCE OBJECTIVES FOR PRECISION, ACCURACY, REPRESENTATIVENESS, COMPLETENESS, AND COMPARABILITY PARAMETERS

5.1 Level of Quality Control

The analytical levels appropriate for sampling and analysis activities in OU 1148 are shown in Table II-1.

5.1.1 Field Sampling

A discussion of quality control samples for the ER Program is presented in Section 6.0 of the Laboratory's ER Program Generic QAPjP (LANL 1991, 0412). The frequency and type of field quality control samples identified in Table 5-1 of the Generic QAPjP will be followed for chemical analysis of samples during the OU 1148 RFI.

5.1.2 Field Measurements

The quality control effort for field measurements performed during the OU 1148 RFI will follow the recommendations presented in Section 5.1.2 of the Generic QAPjP (LANL 1991, 0412).

5.1.3 Analytical Laboratory

The analytical laboratory quality control level of effort for the OU 1148 RFI will follow the recommendations specified in the Environmental Protection Agency (EPA) methods or described in Table 5-2 of Section 5.1.3 of the Generic QAPjP (LANL 1991, 0412).

TABLE II-1

ANALYTICAL LEVELS TO BE EMPLOYED DURING SAMPLING AND ANALYSIS AT OU 1148

ACTIVITY	ANALYTE	ANALYTICAL LEVEL[a]
Field Screening	Combustible vapors and O_2 level in septic tanks	I
	Gross Alpha, Beta, Gamma	I
	VOCs	II
Laboratory Analyses	SW-846 VOCs SW-846 SVOCs SW-846 Metals	III
	Pesticides PCBs Cyanide	III
Radiological Analyses	Tritium Radionuclides[b,c]	V

a EPA 1987, 0086.
b Am-241, Cs-137, Pu-238, Pu-239, Pu-240, Pu-241, Th-228, Th-230, Th-232, Total U, U-234, U-235, U-238, Ra-226, Sr-90, Y-90, Pb-210, Tc-99, Co-60 for MDAG.
c Gross alpha, gross beta, gamma spectroscopy for MDAs J, H, L, TA-54 West and TA-51.

5.1.4 Geotechnical Laboratory

Soil samples for geotechnical analyses will be collected during the OU 1148 RFI. These analyses will use either conventional laboratory procedures [e.g., American Society for Testing and Materials (ASTM)] or Laboratory standard operating procedures (SOPs) as listed in Appendix L of the IWP. In contrast to samples submitted for chemical analyses, field quality control samples are not routinely associated with geotechnical samples. Quality control for geotechnical sample analysis results is prescribed in the specific laboratory SOPs. An additional measure of quality control for geotechnical samples is achieved by the collection of a sufficiently large sample volume to allow for reanalysis of an individual sample if results from the initial aliquot do not meet specific method requirements.

5.2 Analytical Sensitivity

The analytical laboratory quality control acceptance criteria for sensitivity for the OU 1148 RFI will be the same as the analytical protocol discussed in Section 5.2 of the Generic QAPjP (LANL 1991, 0412). The specific protocols with associated Practical Quantitative Limits are provided in the following tables of the Generic QAPjP.

- Table 5-3 for volatile organic compounds
- Table 5-4 for semivolatiles
- Table 5-5 and 5-6 for polychlorinated biphenyls (PCBs)
- Table 5-7 for inorganics
- Table 5-8 for radionuclides
- Table 5-9 for miscellaneous analytes
- Table 5-10 for high explosives

Any specific analyte identified in the tables listed above may be included in the OU 1148 RFI.

5.3 Quality Assurance Objectives for Precision

The quality assurance objectives for the precision of laboratory analyses of OU 1148 RFI samples will follow EPA guidance specified in Section 5.3 and Table 5-12 of the Generic QAPjP (LANL 1991, 0412).

5.4 Quality Assurance Objectives for Accuracy

The quality assurance objectives for the accuracy of laboratory analyses for OU 1148 RFI samples will follow the EPA's guidance specified in Section 5.4 and Tables 5-11 and 5-12 of the Generic QAPjP (LANL 1991, 0412).

5.5 Representativeness, Completeness, and Comparability

The field sampling plans in Section 6.0 of the OU 1148 RFI work plan were developed to meet the sample representativeness criteria described in Section 14.3 of the ER Program Generic QAPjP (LANL 1991, 0412).

Completeness of analytical data from the OU 1148 RFI will be calculated according to the formula presented in Section 14.4 of the ER Program Generic QAPjP (LANL 1991, 0412). The quality assurance objective for analytical data completeness for the Laboratory's ER Program and for the OU 1148 RFI is 90%.

Data comparability for the OU 1148 RFI will be achieved through the use of standard sampling and analytical techniques. Sampling will be performed according to the Laboratory's ER Program SOPs (LANL-ER-SOP) (LANL 1991, 0411). Sample analyses will be performed according to analytical methods referenced in the Generic QAPjP (LANL 1991, 0412) or this OU 1148 RFI QAPjP. Data results will be reported in appropriate units consistent with the existing site data and applicable regulatory levels.

5.6 Field Measurements

Field laboratory measurements for the OU 1148 RFI will be performed according to the "Field Analytical Techniques" procedure described in the Laboratory's ER Program SOPs (LANL 1991, 0411). Adherence to the SOPs will ensure the precision, accuracy, and completeness of the field measurement data.

5.7 Data Quality Objectives

All Data Quality Objective (DQO) elements are covered in various sections of the OU 1148 RFI work plan and the Generic QAPjP (LANL 1991, 0412).

The DQO process, as applied to the OU 1148 RFI, is described in Section 3.0 of the OU 1148 RFI work plan. The tables in Chapter 3.0 present specific objectives for each investigation unit. Each sampling plan in Section 5.0 of the OU 1148 RFI work plan also contains a list of data needs, location figures, and sampling and analytical requirement tables that are specific to each SWMU aggregate.

Data analysis, interpretation, statistical representativeness, and applicability to the conceptual model are discussed in Chapter 3.0 of the OU 1148 RFI work plan, and budgetary and scheduling information relative to anticipated field and laboratory activities is presented in Section 7.0 of the OU 1148 RFI work plan.

6.0 SAMPLING PROCEDURES

Sampling procedures are detailed in Appendix B and supplemented by SOPs listed in Appendix L of the IWP.

Soil and water samples will be collected, as appropriate, using LANL-ER-SOP - 06.03 "Sampling for Volatile Organics," -06.05 "Soil Water Samples," -06.13 "Surface Water Sampling," or -06.14 "Sediment Material Collection" (LANL 1991, 0411). A general description of all types of field investigations is also presented in Section 5.0 of the OU 1148 RFI work plan.

Information regarding required sample containers, volume, preservation, and holding times is presented in LANL-ER-SOP-01.02 "Sample Containers, and Preservation," (LANL 1991, 0411) and in Section 6 of the Generic QAPjP (LANL 1991, 0412).

Instructions for handling, packaging, and shipping of samples are described in general in Section 6.0 and Section 7.5 of the Generic QAPjP and in detail in LANL ER Program SOP-01.03, "Handling, Packaging and Shipping of Samples" (LANL 1991, 0411).

6.1 Quality Control Samples

A discussion of quality control samples for the ER Program is presented in Section 6.1 of the Laboratory's Generic QAPjP (LANL 1991, 0412) and LANL-ER-SOP-01.05, "Field Quality Control Samples" (LANL 1991, 0411). The frequency and type of field quality control samples identified in Table 5-2 of the Generic QAPjP will be followed for chemical analyses of samples during the OU 1148 RFI.

Soil samples for geotechnical analyses will also be collected during the OU 1148 RFI. In contrast to samples submitted for chemical analyses, field quality control samples are not routinely associated with geotechnical samples. Quality control for geotechnical sample analysis results is prescribed in the specific laboratory procedure. An additional measure of quality control for geotechnical samples is achieved by the collection and submittal to the laboratory of a sufficient volume of sample. A large sample volume may allow for reanalysis of an individual sample in the event results from the initial aliquot did not meet specific method requirements.

6.2 Sample Preservation During Shipment

Information on sample preservation during shipment is presented in LANL-ER-SOP-01.02, "Sample Containers and Preservation" (LANL 1991, 0411), and in Section 6.2 of the Generic QAPjP (LANL 1991, 0412).

6.3 Equipment Decontamination

Equipment decontamination is described in Section 6.3 of the Generic QAPjP (LANL 1991, 0412). LANL-ER-SOP-01.06, "Management of RFI-Generated Waste" (LANL 1991, 0411), provides information for proper handling and disposition of wash water and other materials generated during equipment decontamination.

6.4 Sample Designation

Samples will be assigned a unique alphanumeric identifier to provide chain-of-custody control while they are being transferred from the time of collection through analysis and reporting. This information is detailed in LANL-ER-SOP-01.04, "Sample Control and Field Documentation" (LANL 1991, 0411).

7.0 SAMPLE CUSTODY AND DOCUMENTATION PROCEDURES

7.1 Overview

Field and laboratory sample chain-of-custody procedures are described in Section 7.0 of the Generic QAPjP (LANL 1991, 0412). These procedures will be followed for sampling activities conducted during the OU 1148 RFI. The LANL-ER-SOP-01.04, "Sample Control and Field Documentation" (LANL 1991, 0411), also provides guidance for chain-of-custody procedures, including example chain-of-custody records and tags.

7.2 Field Documentation

A sample numbering system developed for the Laboratory's ER Program uniquely identifies each boring location, monitor well, and sample collected. The Laboratory's ER Program numbering system, including standard sample identifiers, identifiers for quality control samples, and the code system to be used is detailed in LANL-ER-SOP-01.04, "Sample Control and Field Documentation" (LANL 1991, 0411).

Section 7.2 of the Generic QAPjP (LANL 1991, 0412) provides sample documentation guidance for field personnel involved with sample collection activities. The Laboratory's ER Program numbering will be followed for all sampling activities conducted during the OU 1148 RFI. All field data collection forms will be reviewed by the OU 1148 field teams manager, or a technical review designee, before being submitted to the Laboratory's ER Records Processing Facility. Incorrect entries will be crossed out with a single line and signed and dated by the person originating the entry and the OU 1148 field teams manager or a technical review designee.

7.3 Sample Coordination Facility

Section 7.3 of the Generic QAPjP (LANL 1991, 0412) provides a discussion of the ER Program activities coordinated by the Laboratory's ER Program Sample Coordination Facility (SCF). The activities described will be performed for the OU 1148 RFI effort. The SCF operation is discussed in Appendix N of the IWP.

7.4 Laboratory Documentation

Laboratory custody procedures associated with sample receipt, storage, preparation, analysis, and general security are described in Section 7.4 of the Generic

QAPjP (LANL 1991, 0412). These procedures will be followed by all laboratories participating in chemical analysis of samples generated during the OU 1148 RFI.

Laboratories providing radiological and geotechnical analyses of OU 1148 RFI samples also will follow chain-of-custody and record-keeping procedures as described in Section 7.4 of the Generic QAPjP (LANL 1991, 0412). Sample storage and sample tracking will be accomplished according to requirements described in the analysis procedure or in the QA Plan of the laboratory.

Acquisition of appropriate QA manuals for all OU 1148 RFI participating laboratories, including LANL EM-9, is the responsibility of the Laboratory's Sample Coordination Facility.

7.5 Sample Handling, Packaging, and Shipping

Sample handling, packaging, and shipping procedures are described in Section 7.5 of the Generic QAPjP (LANL 1991, 0412) and in LANL-ER-SOP-01.03, "Handling, Packaging and Shipping of Samples" (LANL 1991, 0411).

7.6 Final Evidence File Documentation

Final evidence file documentation is described in Section 7.6 of the Generic QAPjP (LANL 1991, 0412) and in the Records Management Plan, Annex IV of the IWP (LANL 1991, 0553).

OU 1148 RFI activities will follow these ER Program-wide procedures and the requirements of ER-SOP-01.01. Additional SOPs will be developed, reviewed, and approved as needed.

8.0 CALIBRATION PROCEDURES AND FREQUENCY

8.1 Overview

Section 8.0 of the Generic QAPjP (LANL 1991, 0412) contains information on the calibration procedures and frequency of calibration for both field and laboratory equipment. Additional information is also cited in the appropriate ER Program SOPs (LANL 1991, 0411), and the manufacturers' equipment manuals.

8.2 Field Equipment

Field equipment that will be used during the OU 1148 RFI includes those instruments described in Section 5.0. Field sampling plans for each of the MDAs are described in Section 5 and Annex III "Health and Safety Project Plan" of the OU 1148 RFI work plan. Specific information regarding calibration procedures and frequency of calibration for field equipment is presented in the applicable Laboratory's ER

Program Section 10.0 SOPs, "Field Screening Techniques," and in the manufacturers' equipment manuals.

The instruments will be calibrated according to manufacturers' specifications before and after each field use.

A record will be established for each field instrument used as part of environmental investigations at the Laboratory to document the instrument's capability of providing accurate and precise measurements. Records on instrument maintenance and calibration will be preserved. Tracking of instrument records will be facilitated by assigning unique numbers to each instrument; the instrument number will correspond to its record file.

8.3 Laboratory Equipment

Section 8.3 of the Generic QAPjP (LANL 1991, 0412) contains general information on the calibration procedures and frequency of calibration for laboratory equipment. Specific instrument calibration procedures for various analytical instruments are described in detail in the QA manuals of the participating laboratories including LANL EM-9. Acquisition of appropriate QA manuals for all OU 1148 RFI participating laboratories is the responsibility of the Laboratory's Sample Management Facility.

The Laboratory's ER Program SOPs (LANL 1991, 0411) have been provided to EPA Region VI under separate submittal and are not attached to this OU 1148 RFI QAPjP.

9.0 ANALYTICAL PROCEDURES

9.1 Overview

Field testing and field laboratory analytical measurements for OU 1148 RFI samples will be performed according to appropriate Laboratory ER Program SOPs (LANL 1991, 0411).

9.2 Field Testing and Screening

Field testing and screening of samples during the OU 1148 RFI will follow appropriate Laboratory ER Program SOPs (LANL 1991, 0411).

9.3 Laboratory Methods

The analytical methods to be used for the OU 1148 RFI for water, soil/sediment samples, air, and other media are those discussed in Section 9.3 and listed in Tables IX.1 and IX.2 of the Generic QAPjP (LANL 1991, 0412). All of the analytical methods presented there are applicable to the OU 1148 RFI.

Additional QA/QC information for the methods applicable to this investigation is presented in Section 5.0 of this OU 1148 RFI QAPjP.

10.0 DATA REDUCTION, VALIDATION AND REPORTING

Data reduction, validation, and reporting will be handled by LANL EM-13 (Environmental Restoration) and subcontractors, using EPA's "Functional Guidelines for Data Validation."

10.1 Data Reduction

Field and laboratory data reduction for the OU 1148 RFI will follow the protocols described in Section 10.1 of the Generic QAPjP (LANL 1991, 0412).

10.2 Data Validation

Field and laboratory data validation for the OU 1148 RFI will follow the protocols described in Section 10.2 of the Generic QAPjP (LANL 1991, 0412).

10.3 Data Reporting

Field and laboratory data reporting for the OU 1148 RFI will follow the protocols described in Section 10.3 of the Generic QAPjP (LANL 1991, 0412).

11.0 INTERNAL QUALITY CONTROL CHECKS

11.1 Field Sampling Quality Control Checks

A discussion of field quality assurance samples for the ER Program is presented in Section 6.1 of the Generic QAPjP (LANL 1991, 0412). The frequency and type of field quality assurance samples identified in the Generic QAPjP will be followed, in general, for chemical analyses of samples during the OU 1148 RFI.

11.2 Laboratory Analytical Activities

The types and frequency of internal quality control samples that apply to OU 1148 RFI laboratory activities will follow those presented in Section 11.2 of the Generic QAPjP (LANL 1991, 0412).

12.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits for field and laboratory operations will be conducted during the OU 1148 RFI. These audits will be performed as identified and referenced in Section 12.0 of the Generic QAPjP (LANL 1991, 0412). Audits will be performed at least once per year or once per task, whichever is more frequent.

13.0 PREVENTIVE MAINTENANCE

13.1 Field Equipment

Preventive maintenance requirements for OU 1148 RFI field equipment will follow specifications described in Section 13.1 of the Generic QAPjP (LANL 1991, 0412). Additional information is detailed in the Section 10.0 ER Program SOPs (LANL 1991, 0411), which define the required equipment checks for each type of field equipment. The Laboratory's ER Program SOPs have been provided to EPA Region VI under separate submittal and are not attached to this OU 1148 RFI QAPjP.

13.2 Laboratory Equipment

OU 1148 RFI preventive maintenance requirements for laboratory equipment will follow the specifications described in Section 13.2 of the Generic QAPjP (LANL 1991, 0412). The elements of the LANL EM-9 Analytical Laboratory preventive maintenance program are discussed in Chapters 12 and 14 of the Health and Environmental Chemistry Laboratory Quality Assurance Program Plan (Gladney and Gautier 1991, 0410).

14.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA

14.1 Precision

Analytical precision for OU 1148 RFI data will be calculated according to the formula presented in Section 14.1 of the Generic QAPjP (LANL 1991, 0412).

14.2 Accuracy

Analytical accuracy of OU 1148 RFI data will be calculated according to the formula presented in Section 14.2 of the Generic QAPjP (LANL 1991, 0412).

14.3 Sample Representativeness

The field sampling plans in Section 5.0 of the OU 1148 RFI work plan were developed to meet the criteria for sample representativeness described in Section 14.3 of the Generic QAPjP (LANL 1991, 0412).

14.4 Completeness

Completeness of analytical data from the OU 1148 RFI will be calculated according to the formula presented in Section 14.4 of the Generic QAPjP (LANL 1991, 0412).

The quality assurance objective for analytical data completeness for the Laboratory's ER Program and the objective for the OU 1148 RFI is 90%.

15.0 CORRECTIVE ACTION

15.1 Overview

The procedures, reporting requirements, and authority for initiating corrective action during the OU 1148 RFI will follow those defined in Section 15 of the Generic QAPjP (LANL 1991, 0412) and in LANL-ER-QP-01.3Q, "Deficiency Reporting."

15.2 Field Corrective Action

Field corrective actions required during the OU 1148 RFI will follow the processes defined in Section 15.2 of the Generic QAPjP (LANL 1991, 0412).

15.3 Laboratory Corrective Action

Laboratory corrective actions required during the OU 1148 RFI will follow the process defined in Section 15.3 of the Generic QAPjP (LANL 1991, 0412).

16.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

16.1 Field Quality Assurance Reports to Management

The OU 1148 field teams manager or a designee will provide a monthly status report to the Laboratory's ER program manager. This report will consist of the information identified in Section 16.1 of the Generic QAPjP (LANL 1991, 0412).

16.2 Laboratory Quality Assurance Reports to Management

The Laboratory QA reports identified in Section 16.2 of the Generic QAPjP (LANL 1991, 0412) will be prepared during the OU 1148 RFI. In addition, the reports to management will include periodic assessments of measured data accuracy, precision and completeness.

16.3 Internal Management Quality Assurance Reports

The internal management QA reports identified in Section 16.3 of the Generic QAPjP (LANL 1991, 0412) will be prepared during the OU 1148 RFI.

References

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ANNEX III

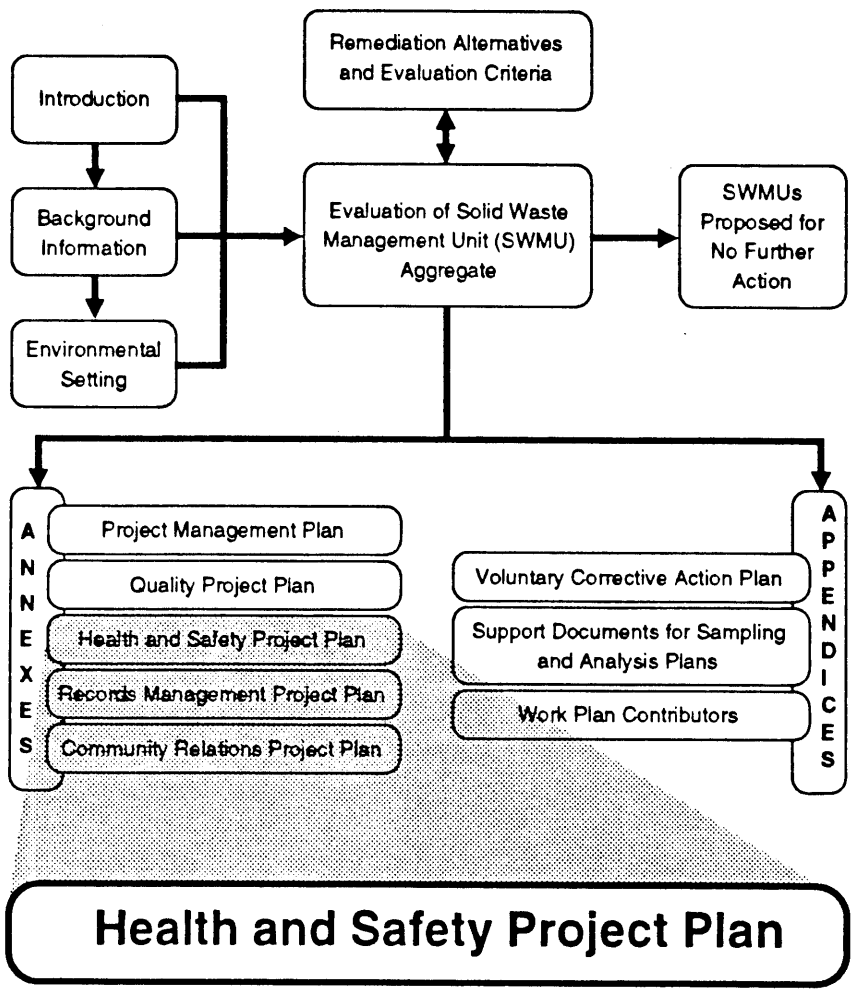
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TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Purpose

This Health and Safety (H&S) Plan provides the framework within which personnel protection will be provided during the implementation of the Resource Conservation and Recovery Act (RCRA) facility investigation at Operable Unit (OU) 1148. Task specific health and safety plans will be prepared prior to initiating any field task. These plans will spell out the specific measures to be taken for personnel protection during implementation of the task. They will also define individual responsibilities for personnel protection during the field investigation. Because personnel involved in field investigations have not been identified, only general responsibilities are described in the OU H&S Plan. Overall health and safety policy for the program is provided in Annex III of the Environmental Restoration Installation Work Plan (LANL 1991, 0553).

As field investigations progress, we may identify more effective measures for personnel protection than presented here. Deviations from this H&S Plan will be documented in the task-specific plan along with the reasons for the deviation. As changes are required, this plan will be updated.

1.2 Organization of the Plan

This plan addresses all aspects of the sampling effort conducted for the RFI. The general responsibilities and individual roles in the implementation of this H&S plan are given Section 2.0. The prerequisites for personnel involved in the OU investigation are outlined in Section 3.0. Brief descriptions of the scope of the OU 1148 RFI and the required sampling tasks are reviewed in Section 4.0. The assessment of hazards associated with the sampling tasks and the specific solid waste management units (SWMUs) are summarized in Section 5.0. To determine hazards requiring personnel protection, air monitoring will be performed during the sampling phase of the investigation as prescribed in Section 6.0. Personnel protection will be accomplished by a combination of engineering controls, work practices, and use of personal protective equipment (PPE) on a task-specific basis. Personnel protection and safety requirements are discussed in Section 7.0. The delineation of work zones and provisions for site control are recommended in Section 8.0. Decontamination procedures for both personnel and equipment are presented in Section 9.0. The emergency response plan and requirements for emergency notification and documentation are included in Section 10.0.

1.3 Basis for the Plan

In addition to the general guidance within the IWP and the SOPs, this plan is based on Laboratory policies, the Laboratory's Environment, Safety, and Health Manual (LANL 1990, 0335), Department of Energy (DOE) orders, Occupational Safety and Health Administration (OSHA) regulations, National Institute for Occupational Safety and Health (NIOSH) recommendations, American Conference of Govern-

mental Industrial Hygienists (ACGIH) recommendations, Nuclear Regulatory Commission (NRC) regulations, Environmental Protection Agency (EPA) guidance, state and local regulations as indicated in the Laboratory's IWP, Annex III (LANL 1991, 0553), and the Laboratory's Hazardous Waste Facility Contingency Plan (Attachment D of the RCRA Permit [EPA 1990, 0306]). These regulations and guidelines have been established to protect workers at sites that contain hazardous and/or radioactive contaminants and therefore apply to personnel engaged in investigating OU 1148. A listing of requirements governing this H&S plan is presented in Table III-1 of the IWP (LANL 1991, 0553).

2.0 OU FIELD WORK ORGANIZATION

This section describes general responsibilities for H&S prescribed by the Laboratory's ER Program, and the specific responsibilities of individuals implementing this H&S plan for the OU 1148 investigation. Included in this section is a listing of the roles within the field organization, provisions for H&S audits, and a mechanism for requesting variances from the H&S plan. Attachment III-1 is an organizational chart showing H&S responsibilities.

2.1 General Responsibilities

Chapter 1 of the Laboratory's Environment, Safety, and Health (ES&H) Manual (LANL 1990, 0335) delineates managers' and employees' responsibilities for conducting safe operations and providing for the safety of contract personnel and visitors. The general safety responsibilities are summarized in Section 5.0 of the H&S plan (LANL 1991, 0553). Specific safety responsibilities for personnel involved in this OU investigation are listed in this section.

2.2 Individual Responsibilities

Both Laboratory employees and contractors have specific H&S safety responsibilities for the ER Program activities. Attachment III-1 is a field work organization chart depicting the responsibilities of the line organization.

2.2.1 Los Alamos Environmental Management and H&S Deputy Division Leaders

The deputy division leaders are responsible for addressing programmatic H&S concerns. They are also responsible for promoting a comprehensive H&S program that includes special areas such as radiation protection, occupational medicine, industrial safety, industrial hygiene, criticality safety, waste management, and environmental protection and preservation.

TABLE III-1

SUMMARY OF POTENTIAL WASTE MATERIALS AND REQUIRED INITIAL LEVELS OF PROTECTION FOR OU 1148

Technical Area MDA Name	Suspected Contaminants	Required Levels of Protection* Field Survey	Surface Sampling	Subsurface Sampling
TA-54 MDA J	High explosives (trace amounts), batteries (nickel) barium sulfate sand, organics (chloroform, phenol), beryllium, asbestos (non-friable), and solvent-soaked rags (acetone, hexane)	TBD	TBD	TBD
TA-54 MDA H	Tritium, radionuclides, HE contamination, beryllium, depleted uranium, various foams, lithium, and magnesium	TBD	TBD	TBD
TA-54 MDA L	Ammonia, metals, empty gas cylinders, acids, trichloroethane, mercury, solvents, trichloroethylene, organics, sodium, potassium, lithium, oil, and inorganics	TBD	TBD	TBD
TA-54 MDA G	Low-level radioactive waste, mixed activation products (MAP), low-level mixed waste, radioactive animal tissues, inorganics, transuranic (TRU) waste, asbestos, solvents, tritium waste, polychlorinated biphenyls, chlorinated hydrocarbons, mixed fission products (MFP), beryllium, and heavy metals	TBD	TBD	TBD
TA-54 West Septic System	Sanitary waste	TBD	TBD	TBD
TA-51 Septic System	Sanitary waste	TBD	TBD	TBD

*Level of protection refers to Levels A, B, C, and D as described in Section 7.2 of this HSPjP. TBD means To Be Determined and that the required levels of protection will be specified in the task specific health and safety plans prepared prior to initiating any field task.

2.2.2 ER Group Leader

The ER Group Leader is responsible for establishing, implementing, and supporting the overall H&S activities for the ER Program.

2.2.3 H&S Project Leader

The H&S project leader (H&SPL) is responsible for updating and implementing the H&S plan (LANL 1991, 0553), and for reviewing the H&S plans for the OUs. The H&SPL is also responsible for coordinating with Laboratory personnel in identifying resources to be used for the H&S plan, and in ensuring Laboratory-wide compliance with all applicable H&S policies and regulations. In conjunction with the field team leaders, the H&SPL oversees daily H&S activities in the field.

2.2.4 OU Project Leader

The OU project leader (OUPL) is responsible for all RFI activities for his/her assigned OU. Specific safety responsibilities include

- preparing, reviewing, implementing, and revising OU H&S documents, and
- interfacing with the H&SPL to resolve H&S concerns.

2.2.5 Field Team Leader

The field team leader is responsible for implementing the SAP, this H&S plan, and the project-specific quality assurance project plan (QAPjP). Specific safety responsibilities include

- ensuring the health and safety of the field team members;
- assigning a site safety officer from the Laboratory Industrial Hygiene Group (HS-5) to ensure compliance with this OU H&S plan;
- being familiar with emergency-response procedures and notification requirements and their implementation;
- acting as a backup to the site safety officer in an emergency;
- maintaining the H&S readiness review check list for all site workers;
- assisting in the daily presentation of the tailgate safety meeting; and
- coordinating field activities with Laboratory personnel and contractors, as needed.

2.2.6 Site Safety Officer

The following responsibilities apply to the site safety officer:

- performing and documenting initial inspections for all on-site equipment;
- evaluating the potential hazards at a site;
- being informed about the results of sample analysis pertaining to H&S as the ER site investigation and remediation work progresses;
- concurring with the field team leader about the location of exclusion area boundaries;
- holding daily tailgate safety meetings with workers, assisted by the field team leader;
- determining protective clothing requirements for workers;
- determining personal dosimetry requirements for workers;
- maintaining a current list of telephone numbers for emergency situations;
- having an operating radio transmitter/receiver in case telephone service is not available;
- maintaining an up-to-date copy of the H&S plan for work at the site;
- maintaining an up-to-date copy of the emergency plan and procedures for the site;
- establishing the safety requirements to be followed by visitors;
- providing visitors with a safety briefing;
- maintaining a logbook of workers and visitors within the exclusion area at a site;
- determining whether workers can perform their jobs safely under prevailing weather conditions;
- taking control of an emergency situation;
- ensuring that all personnel have been trained in the appropriate safety procedures and have read and understood this OU H&S plan, and that all requirements are followed during OU activities;
- conducting daily H&S briefings for the field team leader and field team members;

- conducting daily H&S audits of the work activities; and
- having authority and requiring that field work be terminated if unsafe conditions develop or an imminent hazard is perceived.

The site safety officer will be trained in first aid procedures and in cardiopulmonary resuscitation (CPR); ensure that first aid supplies are available at the site; and know the location of facilities for emergency medical care, including those for injuries that might involve contamination by radioactive materials or hazardous chemicals.

2.2.7 Field Team Members

Field team members are responsible for conducting the assigned work in a safe manner that ensures technically valid and legally defensible data; for observing applicable health, safety and environmental procedures; for using prescribed personal protective equipment; for promptly reporting accidents, injuries, and unsafe conditions; and for participating in required medical and biological monitoring programs.

2.3 H&S Audits

The frequency of these audits will depend on the characteristics of the site and the equipment used.

The site safety officer will perform an audit of the work area daily, or as conditions change, and will document the audit on the Health and Safety Check List form (Attachment III-2). The site safety officer will coordinate with the field team leader to correct any deficiencies. The completed audit form should be retained at the work site to be available for inspection by the Environmental Management (EM) and Health and Safety (HS) divisions, or by other inspectors. In addition, OU readiness check lists must be completed before work starts.

The EM and HS Divisions may also conduct H&S audits separately or concurrently with internal ER audits to ensure compliance with the Laboratory's ES&H manual.

2.4 Variances from H&S Requirements

Where special conditions exist, the site safety oficer may submit a written request for a variance from a specific H&S requirement to the field team leader and the H&SPL. If the field team leader and the H&SPL agree with the request, it will be reviewed by the OUPL or a designee. Higher levels of management may be consulted as appropriate. The H&SPL will evaluate the condition of the request and, if appropriate, grant a written variance specifying the conditions under which the requirements may be modified. The variance will become part of this H&SPlan.

3.0 PERSONNEL PREREQUISITES

This section describes the prerequisites for all personnel involved in site work for OU 1148. Further guidance is provided in Sections 10.0, 11.0, 12.0 and 13.0 of the IWP, Annex III, H&S plan (LANL 1991, 0553).

3.1 Training Requirements

The training requirements for ER Program workers at hazardous sites are established in Section 11.0 of the H&S Plan. The routine or special draining for emergency responders at the sampling locations will include the requirements; H&S training for hazardous waste sites, respiratory protection, radiation safety, and specialized areas such as CPR, first aid, and recognition of high explosive (HE) materials and ordnance.

All site workers must be trained according to Title 29 U.S. Code of Federal Regulations (CFR) Part 1910.120 (OSHA 1991, 0610) before their initial assignment to any project. All site workers, including subcontractors, will receive a minimum of 40 hours of training off site and a minimum of 3 days of actual field experience directly managed by a trained, experienced supervisor. Field team members, including subcontractors, whose work is limited to nonhazardous activities must complete 24 of off-site training and 8 of on-site training. All field team members will be provided with copies of all pertinent SOPs, and will be briefed on their use.

The field team leader must receive a minimum of 8 hours of additional training on program supervision. Each site worker must receive 8 hours of refresher training annually. Certification that training has been completed will be maintained with the project files. Subcontractors must provide certificates of training for the project files of all field team members assigned to the project. Records of training will also be kept at the job site.

3.2 Employee Medical Surveillance Program

Field team members who may be exposed to hazardous materials during ER Program investigations will participate in a medical surveillance program provided by the Laboratory in accordance with 29 CFR Part 1910.120 (OSHA, 1991, 0610) and DOE Order 5480.8 (DOE 1987, 0731), Chapter VIII. According to 29 CFR Part 1910.120, medical examinations are required for all employees who are exposed or who may be exposed to substances at or greater than the established permissible exposure limits (PELs) for more than 30 days per year. Examinations are also required for all employees who wear a respirator for 30 days or more per year, and for members of hazardous materials teams. PELs for potential contaminants at OU 1148 are listed in Table III-2. Such examinations must occur

- before the employee begins the assignment to establish base-line conditions;
- at least every 12 months;

- at termination of employment or reassignment to an area where the employee would not be covered by an examination within the last six months;

- upon notification that the employee has developed signs or symptoms of exposure; and

- upon the exposure of an unprotected employee and in cases where the physician recommends a specific schedule for examination. Suitability of field team members for conducting field sampling activities, including respirator use, will be evaluated and documented by a physician.

Further details of the medical surveillance program are provided in Section 12.0 of the H&S plan. In addition, the program must comply with Laboratory Administrative Requirement (AR) 2-1, "Occupational Medicine Program"; AR 3-6, "Biological Monitoring for Radioactive Materials"; AR 6-4, "Biological Monitoring for Hazardous Materials"; and Laboratory Technical Bulletin (TB) 606, "Biological Sample Monitoring".

3.3 Documentation

The training and medical records of all ER Program workers will be retained in accordance with the requirements in Section 13.1 of the H&S plan. The Occupational Medicine Group (HS-2) will maintain medical records, and the Safety and Risk Assessment Group (HS-3) will maintain training records. In addition, DOE Order 5484.1, "Summary of Exposure Resulting in Internal Body Depositions of Radioactive Materials for CY 19___," and DOE Order 5484.6, "Annual Summary of Whole Body Exposure to Ionizing Radiation" (DOE 1990, 0733) will be submitted by March 31 each year for monitored employees. Preparation of these reports will be coordinated with the Laboratory Health Physics Operations Group (HS-1). Reporting requirements for injuries, exposures, accidents, releases, and unplanned occurrences will be addressed in Section 10.0 of this H&S plan. Emergency telephone numbers are also given on the laminated Laboratory ES&H Policy card that all employees and contractors wear with their photo identification badges.

4.0 SCOPE OF WORK

This section describes the SWMUs within OU 1148 and the tasks to be performed during the sampling phase of the RFI.

4.1 Purpose

The sampling effort supports the RFI by determining the nature and extent of contamination in the SWMUs within OU 1148, and the potential effects on human health and the environment. This determination includes the identification of source points, pathways for migration, and environmental receptors associated with each SWMU. The tasks and activities within the sampling phase are described in the

TABLE III-2
POTENTIAL CONTAMINANTS, OU 1148
IN TECHNICAL AREA 54
EXPOSURE LIMITS

CONTAMINANTS	OSHA CEILING ppm mg/m³	OSHA PEL ppm mg/m³	ACGIH STEL ppm mg/m³	ACGIH TWA ppm mg/m³	ACGIH STEL ppm mg/m³
Ammonia		50.0 35.0	35.0 27.0		
Arsenic		0.5	0.5		
Ethylene glycol	50.0 125.0				
Lead		0.05		0.15	
Mercury	0.1			0.01	0.02
Isopropyl alcohol		400 980	500 1225	400 980	
Stoddard solvent		500 2900		100 525	
1,1,1-Trichloroethane		350 1900	450 2450	350 1900	
Asbestos				2 fibers/cc air	
Beryllium oxide*	0.005	0.002		0.002	
Chromic acid	0.1				
Fluorine		0.1 0.2		0.1 0.2	
Hydrogen fluoride		3.0	6.0	3.0 2.6	
Chlorine	1.0 3.0	0.5 1.5	1.0 3.0	0.5 1.5	
Ethyl alcohol		1000 1900		1000 1900	
Trichlorofluoromethane	1000 5600	1000 5600			
Hydrogen chloride	5.0 7.0			5.0 7.0	
Osmium tetroxide		0.002	0.0006 0.006	0.0002 0.002	
Methyl alcohol		200 260	250 325	200 260	
Methyl ethyl ketone		200 590	300 885	200 590	
Picric acid		0.1		0.1	
Calcium oxide		5.0		5.0	
Sodium hydroxide	2.0	2.0			
Chloroform	50 240			2.0 9.7	
Trichloroethylene	200	100	200 1080	50 270	
Perchloroethylene				25 170	

*Suspected or known carcinogen.

Reference: 29 CFR 1910.1000

SAPs, Section 5.0 of this work plan. This H&S plan will establish procedures for performing activities in a safe manner.

4.2 OU Description

TA-51. The three SWMUs in TA-51 include two multiple-celled water-tight structures (caissons) that are used for research studies on the design of covers to protect and isolate waste burial sites and an active septic system. The research caissons have never managed hazardous waste. The septic system is not expected to be contaminated with hazardous substances. However, the septic system will be investigated for contamination after the Laboratory does a sanitary system upgrade.

TA-54. The 45 SWMUs in TA-54 are organized within the four waste handling/disposal areas, and the three facilities located in the western part of the TA.

- The 24 SWMUs in Area G include low-level solid radioactive waste disposal pits and shafts, radioactive waste storage pits and shafts, surface storage of solid radioactive waste, septic systems, sumps, an underground tank, a waste compactor, and a truck washing pit. A vapor plume of tritium and volatile organic contaminants is present in the unsaturated rocks immediately below Area G. An active monitoring program has determined that the plume does not pose a threat for contamination of groundwater at the present time.

- The SWMU in Area H is a set of nine inactive disposal shafts. Environmental monitoring and disposal records have shown that tritium was disposed in Area H.

- The SWMU in Area J includes three pits and two shafts for disposal of nonhazardous waste. There are no known environmental releases from the area.

- The 13 SWMUs in Area L include inactive chemical waste disposal pits, shafts, and impoundments, storage areas for mixed waste, surface treatment and storage areas for hazardous waste, a PCB storage building, a compressed gas cylinder storage area, a drum compactor, and a sanitary waste holding tank. A vapor plume of volatile organic contaminants is present in the unsaturated rocks immediately below Area L. An active monitoring program has determined that the plume does not pose a threat for contamination of groundwater at the present time.

- The four SWMUs in TA-54 West include a waste staging area, a sump, a truck washing pit and a septic system. TA-54 West is newly constructed and has not been placed in operation so there have been no environmental releases. One of the septic systems serves the waste testing facility; the other serves the former animal holding facility. The septic system is not expected to be contaminated with hazardous radioactive waste. However, it will be investigated for contamination after the Laboratory does a sanitary system upgrade.

- The two SWMUs in the former radiation exposure facility and the former animal holding facility are the active septic systems. The systems are not expected to be contaminated with hazardous or radioactive waste. However, they will be investigated for contamination after the Laboratory does a sanitary system upgrade.

4.2.1 SWMU Sampling Locations

The sampling locations for the OU 1148 SWMUs are specified in the SAPs, Section 5.0 of this work plan.

4.2.2 Topographical Considerations

The environmental setting for OU 1148 is described in Section 3.0 of this work plan. Because some of the SWMUs are located near the edges of Mesita del Buey, accessibility and logistics will be difficult. These activities will require special precautions as outlined in Section 7.0 of this H&S plan.

4.2.3 Meteorological Considerations

The climate of Los Alamos County is reviewed in Section 3.0 of this work plan. Because of the semiarid, mountain climate, the field teams must prepare for a variety of weather conditions during sampling excursions. Field team members may experience heat stress, cold stress, natural hazards, and exposure to lightning and slippery surfaces. These hazards and the equipment necessary to minimize them are addressed in Section 7.0 of this H&S plan.

4.2.4 Facility Resources

The roads, water supply, electricity, telephones, medical facilities, evacuation routes and fire suppression facilities for OU 1148 are shown in Figures III-1 through III-5.

4.3 Description of Tasks

Various tasks may be conducted to determine the nature and extent of contamination within OU 1148. These tasks and activities will include collection of soil gas samples from new or existing soil-vapor monitoring wells, placement of passive air monitors on the ground surface; high-volume air monitoring for wind-borne contaminants; surface-water run-off sampling and sediment collection from outfall points, drainage areas, and sediment traps; excavations, deep-well borings and angle borehole drilling beneath waste-storage pits and impoundments; tritium sampling; and a pilot study to support the voluntary corrective action plan (VCAP) to remediate the vapor plume surrounding TA-54 MDA L (Annex I of this work plan). Each task is analyzed for its specific hazards and associated protective measures in Sections

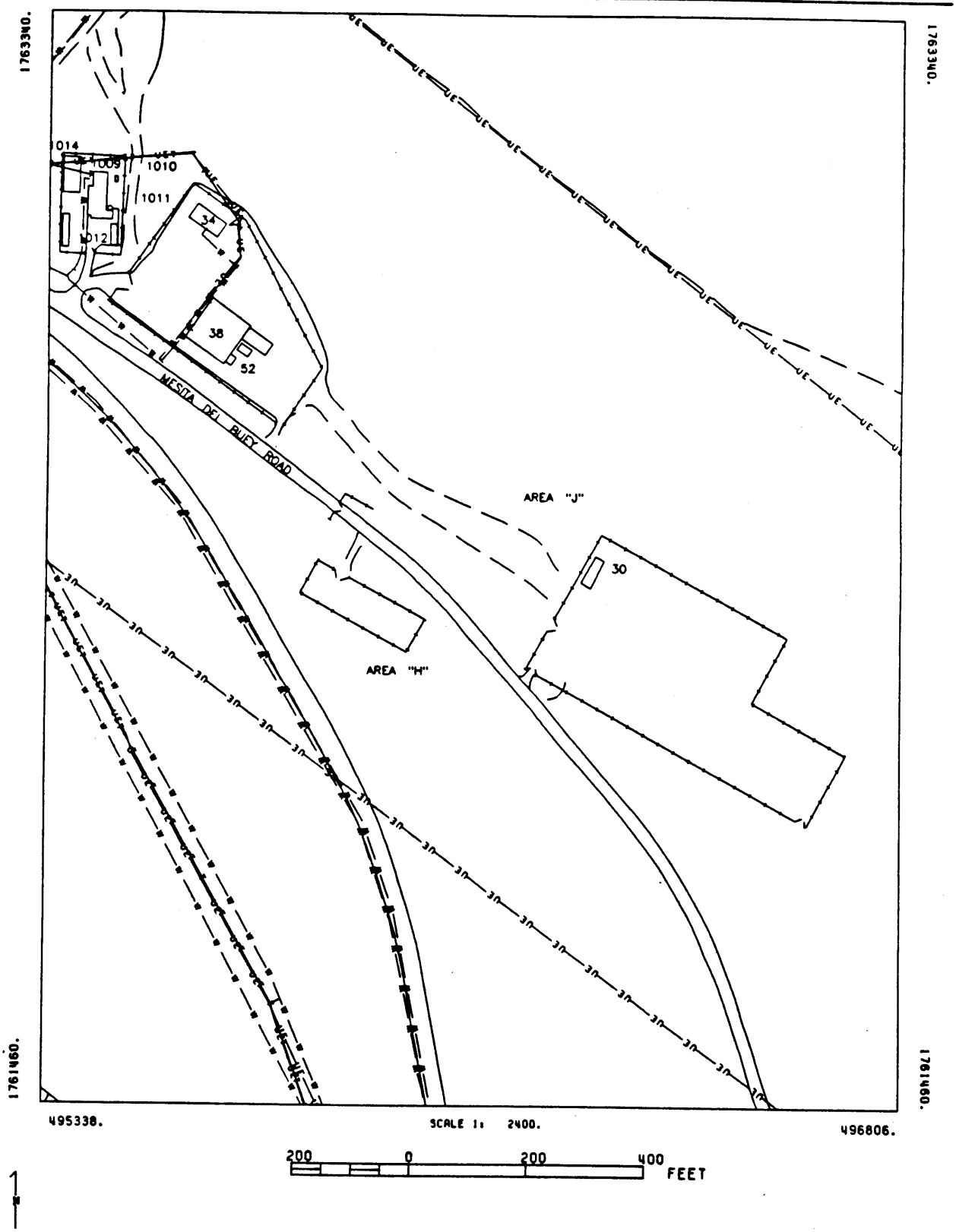


Figure III-1 Utilities Servicing MDA J and MDA H.

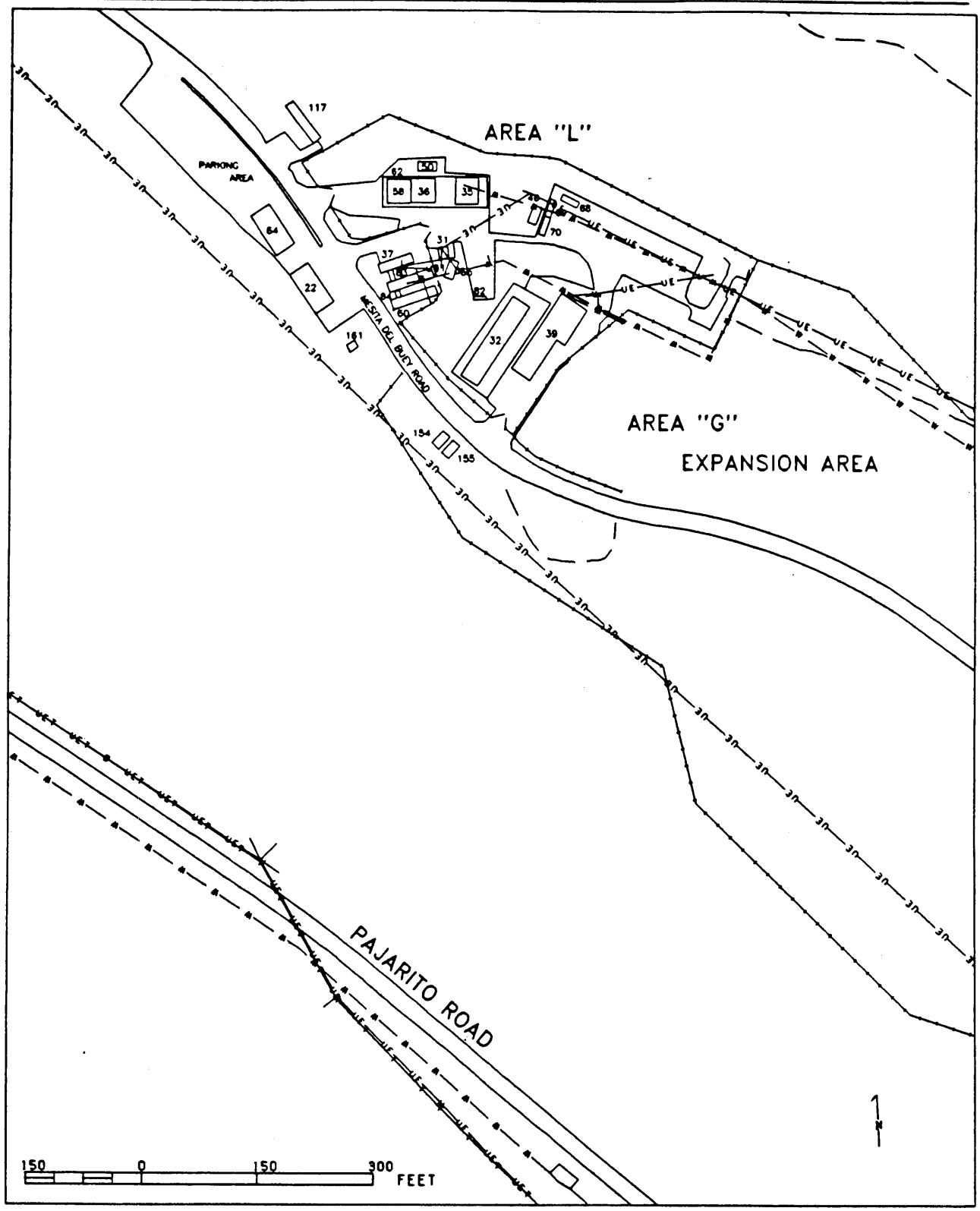


Figure III-2 Utilities Servicing MDA I.

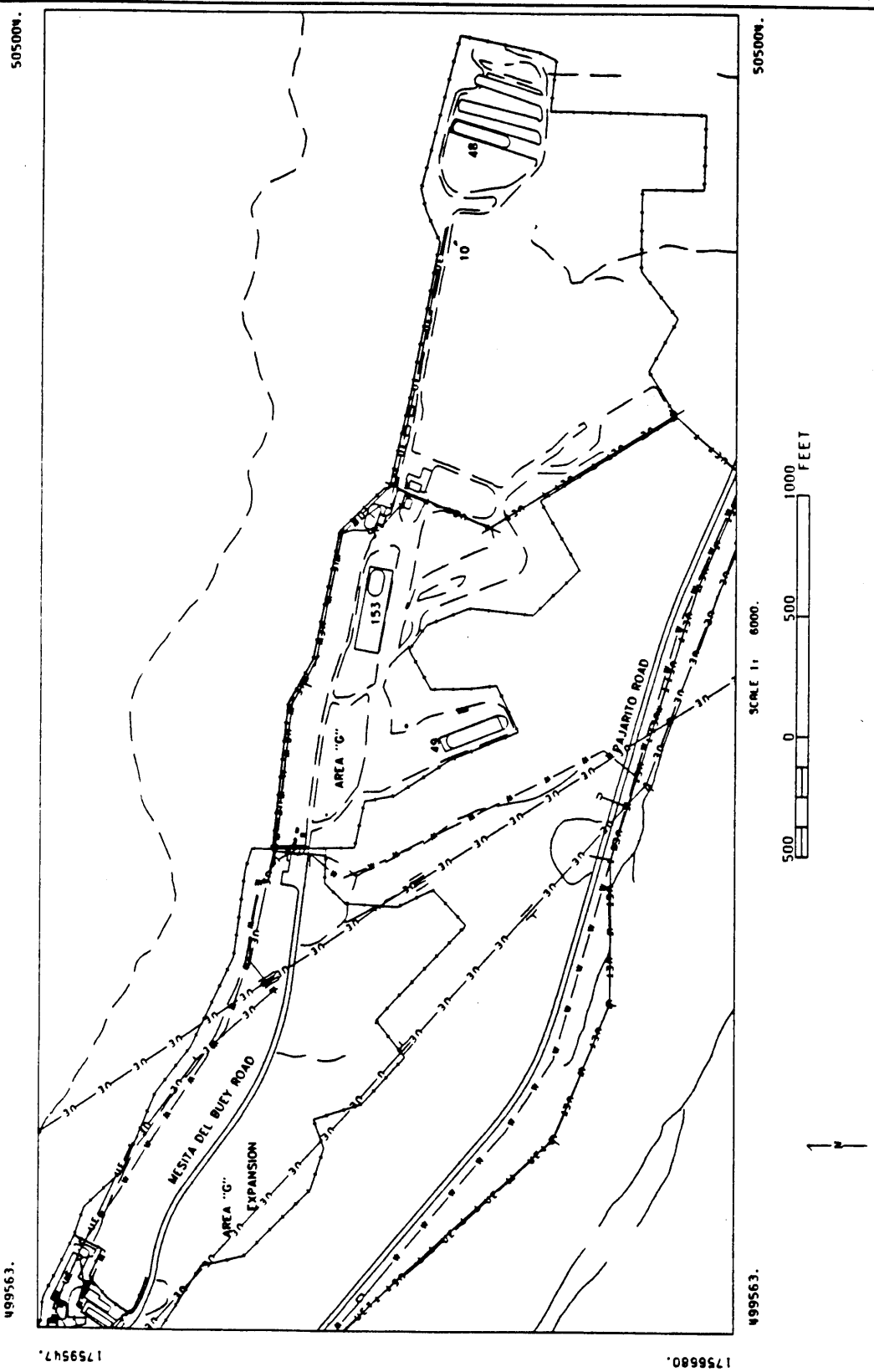


Figure III-3 Utilities Servicing MDA G.

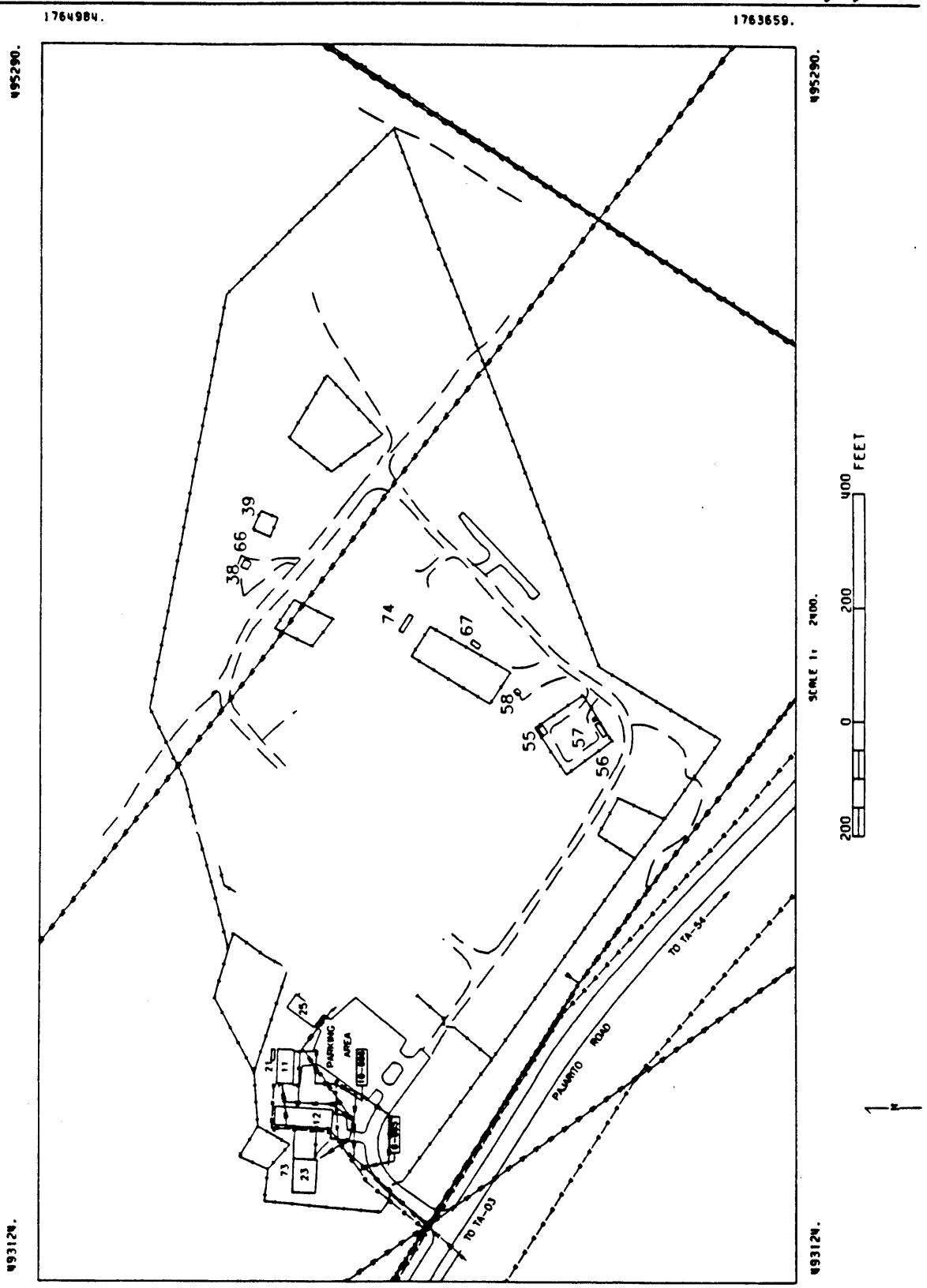


Figure III-4 Utilities Servicing TA-51.

5.0, 6.0 and 7.0 of this H&S plan. Most of the sampling efforts are nonintrusive because of the high hazard potential to the investigators.

5.0 HAZARD ASSESSMENT

This section presents the hazards that may be encountered by site workers. The tasks and activities scheduled for OU 1148 will be analyzed with respect to these hazards.

5.1 Types of Hazards

The types of hazards that may be encountered during work in OU 1148 are discussed below.

5.1.1 Oxygen Deficiency

The oxygen content of normal atmospheres is approximately 21% by volume. Oxygen-deficient atmospheres are defined in 29 CFR Part 1910.120 (OSHA 1991, 0610) as atmospheres in which oxygen by volume is less than 19.5%. As the percentage of oxygen approaches this level, workers exhibit symptoms of oxygen deprivation that include impaired attention, coordination, and judgment as well as an increase in breathing and heart rate.

Oxygen-deficient atmospheres may result from the displacement of oxygen by another gas, or from the consumption of oxygen during a chemical reaction. Because the sampling activities for OU 1148 will be conducted outdoors, oxygen-deficient atmospheres are not expected. However, the field team must be aware of the potential for oxygen deficiency in confined spaces, such as natural depressions, excavations, or trenches.

5.1.2 Explosivity/Flammability

The following are potential sources of explosive or flammable hazards in OU 1148:

- disturbance of trace quantities of nonreactive HE residues (TA-54, MDAs J and H);
- ignition of explosive or flammable chemicals;
- ignition of materials due to oxygen enrichment;
- sudden release of materials under pressure; and
- chemical reactions that may result in explosion, fire, or heat.

These conditions may result in hazards of intense heat, open flame, smoke inhalation, flying debris, and the release of toxic chemicals. The field team members

must be aware of materials specific to each SWMU that may contribute to the aforementioned conditions.

Each explosive or flammable gas or vapor has a range of concentrations at which it will explode or burn in the presence of an ignition source. The explosive or flammable limit represents that range for each chemical and is therefore a useful indicator of explosive or flammable hazards.

5.1.3 Radiological Hazards

Radiological constituents emit one or more of the three types of ionizing radiation: alpha, beta, and gamma. Because ionizing radiation can cause biological harm to the body, field team members must be aware of any areas in which radiological hazards exist. The presence of radiological wastes is confirmed in TA-54 MDAs L, G, and H (Section 5.0 of this work plan).

The following are primary pathways by which field team members may be exposed to radiological hazards during sampling:

- inhalation of contaminated particulates or vapors;
- inadvertent ingestion of contaminated materials;
- dermal absorption of contaminated particulates or vapors through wounds;
- injection of contaminated particulates into the body through puncture wounds; and
- exposure to direct gamma radiation from contaminated materials.

Indicators for radiological exposures are exposure rates and concentration of radiation in soil, water, and air. These rates are expressed in rems or millirems (mrem). Radiation monitoring is discussed in Section 6.3 of this H&S plan.

5.1.4 Toxicological Hazards

Exposure to toxic chemicals can result in a wide range of adverse effects depending on the specific toxicological action of the chemical, the concentration, the route(s) of exposure, the duration and frequency of exposure, and personal factors.

The known historical uses of TA-54 confirm the presence of chemical wastes in the SWMUs. Types of potential toxicological wastes include metals, mercury, laboratory wastes, hydrocarbon fuels, organic solvents, acids, caustics, asbestos, and polychlorinated biphenyls (PCBs). The primary pathways for chemical exposure include the following:

- inhalation of toxic gases, vapors, or contaminated particulates;
- inadvertent ingestion of contaminated materials;

- dermal absorption through contact with vapor, contaminated liquids, or contaminated particulates;
- dermal absorption of vapors, contaminated liquids, or contaminated particulates through wounds; and
- injection of contaminated liquids or contaminated particulates through puncture wounds.

Information for known contaminants includes published exposure limits and symptoms of exposure. The published exposure limits consist of the permissible exposure limits (PELs) established by OSHA in 29 CFR Part 1910.120, Subpart Z; the recommended exposure limits (RELs) set forth by NIOSH in Recommendations for Occupational Health Standards; and the threshold limit values (TLVs) developed by the ACGIH in Threshold Limit Values and Biological Exposure Indices for 1990-91 (ACGIH 1990, 0726).

TLVs refer to airborne concentrations of substances to which nearly all employees may be repeatedly exposed on a daily basis without adverse effects. They are founded on the best available information from industrial experience and animal or human studies. Because of the wide variation in individual susceptibility, a small percentage of workers may experience discomfort from some substances at concentrations lower than recommended values. Policy has been to use these guidelines for good hygienic practices; however, whenever applicable, stricter guidelines may be used.

Currently, exposure guidelines to pesticides and other chemical substances are regulated by OSHA. These exposures are based on the time-weighted average (TWA) concentration for a normal 8 h workday and a 40 h workweek. Several chemical substances have short-term exposure limits (STELs) or ceiling values that allow a maximum concentration to which workers can be exposed continuously for a short time without suffering irritation, chronic or irreversible tissue damage, or narcosis of a degree sufficient to result in accidental injury, impair self rescue, or substantially reduce work efficiency.

The STEL is defined by the ACGIH and OSHA as a 15 min TWA exposure that should not be exceeded within a 2 h period during a workday, even if the 8 h TWA is within applicable limits. OSHA requires that the 15 min ceiling concentration never be exceeded for a certain chemical constituent. The ceiling concentration notation appears as the letter "C" following the chemical name in CFR Part 1910.120, Subpart Z.

A "skin" notation may appear under certain chemical-substance listings. This notation refers to the potential contribution to the overall exposure by the cutaneous route, including mucous membranes and eyes, either by airborne or direct contact. Little quantitative data are available describing absorption as a function of the concentration to which the skin is exposed. Biological monitoring may be considered to determine the relative contribution of dermal exposure to the total dose.

ACGIH and OSHA have recognized from epidemiological studies, toxicology studies, and, to a lesser extent, case histories that certain chemical substances are

potentially carcinogenic in humans. Because of the long latency period for many carcinogens, timely risk-management decisions on the results of such information are often impossible. Two categories of carcinogens, confirmed human carcinogens and suspected human carcinogens, are designated on the basis of the most current literature and information. These chemical categories are derived from either limited epidemiologic studies and clinical reports of single exposure, or through test methods of carcinogens in one or more animal species. In the case of a known human carcinogen, the worker who is at risk of exposure must be properly equipped to ensure virtually no contact with the chemical constituents. In the case of a suspected human carcinogen, worker exposure by all routes must be carefully controlled by the use of personal and respiratory protection, and administrative or engineering controls.

The symptoms associated with exposure will depend on the chemical and the conditions of exposure. Table III-1 lists many of the suspected wastes present at the SWMUs within the confines of OU 1148. Any adverse physiological reaction should be considered extremely serious and will be reported to the field team leader immediately.

5.1.5 Corrosive Hazards

Corrosive materials such as acids and bases can destroy tissues on contact. Depending on the strength of the corrosive, symptoms range from skin or eye irritation to severe burns. Corrosives may also damage equipment and protective gear. One indicator of the corrosive nature of a material is its pH. Another indicator is its strength or concentration.

Historical evidence indicates the storage or disposal of acids and bases in several of the SWMUs. Field personnel must be cognizant of opportunities for exposure to corrosive materials through generation of vapor or gas clouds, splashing of contaminated liquids, or contact with contaminated soils or sludges.

5.1.6 Biological Hazards

Field team members are likely to encounter biological hazards in some areas of OU 1148. Contact with wildlife such as rattlesnakes, rodents, mosquitoes, ticks, spiders, and fleas may be hazardous. Infectious agents can be transmitted as a result of abrasions or puncture wounds from objects such as broken glass, scrap metal, and other debris. Field team members must also be aware of hazardous biological agents conveyed through unhygienic practices such as failing to sanitize respirators and drinking, eating, or applying makeup or lip balm on site.

5.1.7 Physical Hazards

OU 1148 sampling activities may present a number of potential physical hazards including the following:

- general physical exposures,

- noise,
- working in confined spaces,
- working around potentially energized electrical equipment,
- working around heavy equipment and machinery,
- inadequate housekeeping,
- use of mechanical and flame cutting equipment,
- materials handling,
- temperature extremes,
- excavations,
- underground hazards,
- traffic,
- compressed gases and systems,
- breaking concrete,
- topography, and
- lightning.

5.1.7.1 General Physical Exposures

Field team members will handle a variety of chemicals and materials during sampling. The primary physical hazards will be exposure to acids, caustics, and various effluent waste streams that may contain petroleum or solvent sludge. Field team members may be exposed to these materials through inhalation, skin absorption, and ingestion. Physical hazards also include personnel encounters with energized and pressurized equipment, waste materials, and work conditions that may cause slips, trips, falls, or cuts.

5.1.7.2 Noise

The operation of the vehicles, machinery, and equipment necessary to conduct the sampling activities can create a noise level exceeding 85 decibels (dBA), as measured with a standard sound-level meter. This noise level may lead to temporary or permanent hearing loss.

5.1.7.3 Working in Confined Spaces

A confined space is defined as a work location that has limited access/egress or inadequate natural ventilation. Personnel may need to enter such areas for inspection and sampling. Potential hazards associated with confined spaces include higher-than-normal concentrations of chemical contaminants, flammable atmospheres, possible asphyxiation, and physical hazards, including slips, trips and falls.

5.1.7.4 Working around Potentially Energized Electrical Equipment

The human body conducts electricity. Contact with an electric circuit combined with simultaneous contact with a grounded object, such as damp concrete, steel, or other metal, will cause the current to flow through the body. Current will also flow through the body if any two body parts come in contact with any two wires that are part of the

same electrical system. In addition to burning skin, electric current frequently interferes with the normal rhythm of the heart and can cause it to stop beating. The heart does not automatically start beating even after the body is removed from the electric current, therefore, CPR must be administered.

The effects of electric shock on the human body are as follows:

- 1 MILLIAMPERE is barely perceptible; there is no real danger.
- 3 to 9 MILLIAMPERES may cause involuntary muscle reactions that could result in bruises, fractures, or even death if the reaction causes a collision or fall.
- 9 to 75 MILLIAMPERES may cause involuntary muscle reactions, or possible respiratory paralysis.
- 75 MILLIAMPERES to 4 AMPERES can cause possible fibrillation (ineffective, erratic pumping) of the heart.
- 4 AMPERES OR GREATER can cause immediate cardiac arrest (heart stoppage).

Shock from high-voltage/current sources can cause severe external and internal burns. In addition, sparking electrical contacts are a potential source of ignition.

5.1.7.5 Working around Heavy Equipment and Machinery

The size of the equipment, the driver's limited range of vision, and underfoot and overhead hazards can lead to crushing, tripping, falling, cutting, or puncturing. The high noise levels created by the equipment can also cause injury.

5.1.7.6 Inadequate Housekeeping

Inadequate housekeeping can lead to congestion, disorder, dirt, waste, trash, and obstacles and can lead to slipping, tripping, and falling, which can result in strains, sprains, broken bones, bumped heads, and fatalities.

5.1.7.7 Use of Mechanical and Flame Cutting Equipment

Welding and cutting operations can create sources of ignition and airborne-contaminant sources. Cutting equipment and compressed-gas cylinders present potential physical, electrical and flame hazards such as welding flash and welding burns.

5.1.7.8 Materials Handling

Manual materials handling can lead to cuts, bruises, splinters, mashed fingers and toes, fractures, and a variety of strains and sprains from lifting, handling, and/or dropping loads. Wire rope used in rigging and lifting may have broken strands and frayed ends, leading to punctures and cuts. Banding wraps used to secure loads could snap, leading to crushing, lacerations, and puncture wounds.

5.1.7.9 Temperature Extremes

Site activities may take place during either excessively hot or cold weather, creating the following heat- and cold-related problems:

- HEAT RASH causes irritation and decreases a person's ability to tolerate heat. It is aggravated by chafing clothing.
- HEAT CRAMPS are caused by a chemical electrolyte imbalance brought about by profuse perspiration combined with inadequate water intake that results in muscle spasm and pain in the extremities and abdomen.
- HEAT EXHAUSTION occurs when stress on various organs to meet increasing demands to cool the body results in shallow breathing; pale, cool, moist skin; profuse sweating; dizziness; and lassitude.
- HEAT STROKE is the most severe form of heat stress. It must be treated immediately by cooling the body or death may result. Symptoms include red, hot, dry skin; no perspiration; nausea; dizziness and confusion; strong, rapid pulse; and coma.
- FROSTBITE is characterized by pain, reddening of tissue, loss of dexterity, and a tingling or lack of sensation in the affected extremities.
- HYPOTHERMIA symptoms include pain and loss of dexterity in the extremities, severe or uncontrollable shivering, inability to maintain normal rate of activity, and excessive fatigue, drowsiness, or euphoria.
- SEVERE HYPOTHERMIA leads to clouded consciousness, low blood pressure, cessation of shivering, dilated pupils, unconsciousness, and possibly death.

5.1.7.10 Excavations

Excavation will take place at some of the SWMUs to provide access to spaces for soil and water sampling. Excavations pose a significant threat to employees if they are not carefully controlled. An improperly dug or shored excavation can collapse and any excavation presents a fall hazard.

5.1.7.11 Underground Hazards

Underground hazards are those that occur when subsurface structures are encountered during drilling or excavation. These structures include gas utilities, power lines, product lines, concrete vaults, tanks, etc. Unexpected encounters with these structures creates the potential for electrocution, explosion, spills, or other injuries to the crew.

5.1.7.12 Traffic

The possibility of vehicle-related injury or accident is inherent to all aspects of field work. Vehicle-related accidents may occur during travel to or from the site as well as during on-site activities. Accidents involving vehicles are highly likely, given the fairly continuous Laboratory activities and the use of heavy equipment during several of the planned work tasks. Additionally, work may take place in roadways on which there is heavy vehicle traffic.

5.1.7.13 Compressed Gases and Systems

The following hazards are associated with compressed-gas cylinders and systems such as compressors:

- flying objects such as dust, dirt discharged from a cylinder-valve opening, or a whipping compressor hose (drilling in Level B at MDAs L and G);
- explosion and/or fire caused by a leaking system (MDA L); and
- a damaged cylinder valve that causes the cylinder to become a missile (MDA L).

5.1.7.14 Breaking Concrete or Asphalt

Accessing sampling areas will sometimes require breaking through a concrete or asphalt pad. The following hazards may be present during this operation:

- a possible increase in airborne concentrations of site contaminants, particularly if the ground is heavily saturated;
- dust exposure from a concrete saw, electric hammer, or drill use;
- flying debris;
- noise;
- vibration of the hands and body of an employee operating a jackhammer; and

- increased likelihood of electrical shock to an employee operating a jackhammer

5.1.7.15 Topography

Injuries from slips, trips, and falls in OU 1148 may occur around uneven terrain, slippery surfaces, embankments, cliffs, excavations, heavy equipment, and areas littered with debris.

5.1.7.16 Lightning

Fire is the most common danger associated with lightning, but explosions, falling trees, power outages, and momentary blindness caused by the flash are other examples. Field personnel hit by lightning will almost certainly be severely injured or killed. Lightning is a significant hazard at the Laboratory during the summer months.

5.2 Task-Specific Hazard Assessment

Three major categories of sampling tasks (field surveys, surface sampling and subsurface sampling) will be conducted during this sampling effort. Various activities will be performed under each of these tasks, depending on which SWMU is being investigated. The details for the tasks are described in the SAPs, Section 5.0 of this work plan. Potential hazards associated with the tasks are evaluated below. Protective measures to be employed during the tasks are outlined in Section 7.0 of this H&S plan.

5.2.1 Field Surveys

Passive air monitoring at the soil/air interface will be conducted in an attempt to define the source term and to delineate the extent of the vapor plume beneath MDAs J, H, L, and G at TA-54. Oxygen-deficient and flammable hazards are not anticipated during these surveys, however, field team members should be aware of the potential for such hazards in low-lying areas. It is possible that field team members may encounter radiation and chemical hazards through contact with contaminated surface soil or dust or through inhalation of dust, and radiological field surveys will be conducted. Biological hazards may be encountered through poisonous or infectious agents and unhygienic practices. Physical hazards include the potential for slips, trips, and falls during the surveying of uneven terrain or at the edges of a mesa; the potential for heat and cold stress when working outdoors for a prolonged period of time; and lightning strikes.

It may be necessary at some sampling locations to drill through asphalt or concrete, disturbing potentially contaminated soil. Exposure to the soil through drilling is greater due to the generation of soil cuttings. Contact with soil or dust and inhalation hazards for dust are possible. Electrical hazards exist in the form of overhead and underground utility lines as well as any electrical connections associated with drill

rigs. Other potential hazards involved in drilling activities include noise, pinch points, rotating equipment, and high-pressure hydraulic lines.

5.2.2 Surface Sampling

The surface sampling program will consist of surface-water run-off and soil or sediment sample collection from outfall points, drainage areas, and sediment traps.

Surface sampling of soil and sediment is typically a low-risk activity. Oxygen deficiency and explosive or flammable vapor/gas hazards will generally not be a problem unless the sampling point is in a low-lying area where gases or vapors can accumulate. Radiological and chemical contaminants may be present in the top 6 in. of soil. Dermal contact with contaminated soil, sediment, and dust or inhalation of dust are possible. Field team members will exercise caution in the presence of biological hazards such as animals, infectious agents, and infectious waste. Physical hazards such as slips, trips, and falls are site-specific. Working extended hours and/or wearing protective clothing on hot days can lead to heat-related hazards. The possibility of lightning strikes exists if surface-water run-off sampling is undertaken during summer thunderstorm activity.

5.2.3 Subsurface Sampling

The subsurface sampling program may consist of the following activities:

- vertical and angle boreholes to investigate contamination beneath waste-storage pits, shafts and impoundments;
- tritium sampling;
- a pilot study to support the VCAP to remediate the vapor plume surrounding TA-54 MDA L (Appendix A of this work plan); and
- trenches and excavations to sample beneath septic systems in TA-51 and TA-54 West.

These activities involve the former locations of pits, shafts, and impoundments and may be associated with oxygen-deficient atmospheres, and could result in explosive/flammable conditions because of the potential for contamination by solvents and fuels. Drilling and excavation activities may enhance volatilization of these materials. The potential for the accumulation of explosive and/or flammable gases and vapors will be greatest in excavated areas and trenches. Because of the history of radionuclide and chemical storage and disposal in OU 1148, the potential for radiation and toxic hazards exists. Because some of the sampling locations will be chosen on the basis of the results of the radiological survey, soil and sediment samples may contain concentrations of contaminants. A related problem is the potential for corrosive hazards that may have resulted from disposal of acids in some of the SWMUs. The primary exposure pathways are potential dermal contact with contaminated soil, sediment, dust, or waste, and the inhalation of contaminated dust and volatiles arising from disturbing the soil during drilling, backhoeing, and excavating.

Biological hazards also pose a potential hazard for all of the activities under this task. These include contact with animals or insects, infectious agents, and infectious waste.

The use of drill rigs and backhoes presents possible physical hazards such as noise, pinch points, and the failure of safety systems. Overhead and underground utilities must be located in advance of such operations. Other electrical hazards may involve short circuits within equipment or electric shock when using electrical equipment in wet conditions.

Field team members must be aware of slips, trips, and falls around cliffs, slippery surfaces, uneven terrain, excavations, and trenches. In addition, excavated areas and trenches may collapse if they are not properly prepared.

In some cases, field team members may be wearing respiratory protection and protective clothing. This equipment will increase the potential for heat stress.

5.3 SWMU-Specific Hazard Assessment

Hazards which are common to all SWMUs in OU 1148 are discussed in Sec. 5.1 of this H&S plan. Table III-1 lists the proposed sampling activities and the suspected chemical and radiological contaminants specific to each of the SWMUs for OU 1148. The initial level of protection required is also listed.

6.0 AIR-MONITORING PROGRAM

In accordance with 29 CFR Part 1910.120 (OSHA 1991, 0610), an air-monitoring program will be implemented during the sampling activities under this work plan. The objectives of the air-monitoring program will be to identify and quantify levels of hazardous substances in the air, to determine the appropriate level of personnel protection, to determine the need for medical monitoring, to delineate the boundaries of work zones, to ensure that decontamination procedures are effective, and to protect public health and safety. In addition to the initial monitoring at the site, periodic monitoring is required when

- work begins in a different portion of the site;
- contaminants other than those previously identified are being handled;
- a different type of operation is initiated (i.e., monitoring volatile materials at a soil boring versus at a drum opening); and/or
- working with leaking drums or containers, or in areas with obvious liquid contamination.

Instruments should be read at ground, waist, and head levels to obtain representative readings of ambient air. Appropriate measurements will also be made in confined spaces, such as trenches and excavations, and within boreholes, well heads, and drum openings.

This section provides a brief description of the monitoring equipment that will be used to detect hazards posed by various airborne contaminants and to determine the action level that will be observed during work in OU 1148. The subsections are listed in the order of the most immediate hazards. Additional guidance is available in Sections 8.0 and 7.0 of the H&S plan. Operating procedures for the instruments are in the ER Program SOPs.

6.1 Oxygen Deficiency

An oxygen indicator will be used to detect oxygen-deficient conditions in confined spaces, low-lying areas, or in spaces that are not ventilated frequently. The action level for oxygen is 19.5%. Areas in which levels are below 19.5% must be evacuated and ventilated. In addition, oxygen-rich atmospheres create an increased potential for fires. Therefore, the affected area will also be evacuated if oxygen levels exceed 25%. If evacuation is necessary, the area will be ventilated and the site safety officer will continue monitoring the oxygen levels.

6.2 Explosivity/Flammability

A combustible-gas indicator (CGI) will be used to monitor for explosive or flammable atmospheres. The presence of residual flammable and combustible liquids is possible at several SWMUs in OU 1148. The potential for explosion or fire occurs during drilling or trenching. Field team members should also be cautious in enclosed areas where flammable/combustible gases could collect. Because some SWMUs may contain unknown flammable constituents, combustible-gas monitoring should be performed. The action level for explosive/flammable gases is 10% of the lower explosive limit (LEL). If this action level is exceeded, all activities in the area will cease, the work area will be evacuated, and appropriate safety measures (such as removal of ignition sources and ventilation of the area) will be implemented. The site safety officer will obtain continuous CGI readings. Because CGI instruments will not detect HE, appropriately trained personnel will need to screen for these hazards.

6.3 Radiological Hazards

A variety of radiation survey detectors and other equipment will be used to determine the presence of radiological hazards. A microroentgen (gamma scintillator) meter or a Geiger-Müller detector will be used to measure gamma exposure. Alpha scintillators will be used to screen soil cores and to scan personnel leaving the contaminated zone. This monitoring program will comply with the requirements of DOE-AL Order 5480.1A (DOE/AL 1982, 0724). This work will be conducted by HS-1 personnel.

Field team members should monitor the area before commencing sampling activities. Continuous monitoring should be conducted because objects such as drums, tanks, and scrap metal provide a certain amount of shielding against radioactive emissions. Conditions may change as these objects are moved or otherwise disturbed. Resuspension of contaminated soil can result in inhalation hazards.

An action level for gamma radiation of 1 mrem/h is recommended in the EPA Standard Safety Operating Guides (SOSG) (EPA 1988, 0609). If 1 mrem/h is encountered, the area will be evacuated (or isolated) and the assistance of a radiation health physicist will be obtained before work on the site is resumed.

Radiation exposures will be monitored through the use of thermoluminescent dosimeters (TLDs). TDLs will be supplied by the Laboratory and will be read monthly. Radiation exposures will be as low as reasonably achievable (ALARA) according to DOE policy. Action levels are stated in DOE Order 5480.11, "Radiation Protection for Occupational Workers" (DOE 1988, 0076).

6.4 Toxicological Hazards

Because no single instrument can detect all toxic materials, a variety of instruments will be used to determine the presence of potentially toxic airborne constituents. While some of these instruments can be calibrated to identify and quantify a particular substance, the field team will most likely encounter mixtures of substances within the SWMUs. In these cases, the instruments will be used as survey tools and the measurements will represent a gross indication of the materials present. As more information on SWMU contents becomes available, chemical-specific detectors or laboratory analysis can be employed for qualitative and quantitative purposes.

6.4.1 Photoionization Detector

A photoionization detector (PID) is a portable, nonspecific vapor/gas detector that uses an ultraviolet radiation source to ionize chemical constituents. The PID is capable of detecting a variety of organic and inorganic chemicals depending on the chemical-specific ionization potential of each constituent. PID instruments and trained operators will be provided by the Laboratory's Industrial Hygiene Group, HS-5.

For most SWMUs, the PID will be used as a survey tool to indicate total volatile organics/inorganics in air. The data will be used to indicate possible "hot spots" on the site, to monitor operations such as borehole drilling, and to aid in decisions on PPE. Because the exact concentrations of each constituent in the mixture will not be known, the generic guidelines recommended by EPA for the selection of protective equipment under unknown conditions will be used. These guidelines are discussed in Section 9.1 of the IWP, Annex III, H&S plan (LANL 1991, 0553) and in Section 7.2.1.1 of this health and safety plan.

In cases where a single constituent has been identified at a SWMU, the PID may be calibrated for that particular chemical and used for quantitative measurements. If specific calibration is not possible, the relative response of the compound can be used to estimate the concentration. Relative response is the instrument response to the chemical of interest compared with the instrument response to the chemical used for calibration. The relative response is expressed as a percentage. Other options for quantitative instrumentation are described in the following text. The action level will be the most protective exposure level for a given chemical. The instrument will be calibrated each time it is turned on.

6.4.2 Flame Ionization Detector

A flame ionization detector (FID) ionizes organic materials by means of a hydrogen flame. This instrument is capable of detecting a wide range of organic constituents, including methane. As in the case of the PID, it is useful to know the relative response factor for suspected contaminants. A FID can be used in both the survey and the quantitative mode. The instrument and trained operator will be provided by HS-5.

6.4.3 Colorimetric Tubes

A colorimetric tube is a glass tube that is typically packed with an absorbent that has been impregnated with a chemical reagent. This chemical reagent is specific for a given chemical or group of chemicals. When a specified volume of air is drawn through the tube, the airborne contaminant reacts with the reagent to produce a stain. The tubes are calibrated such that the length of the stain corresponds to an approximate concentration. These tubes may be used in cases in which the presence of a chemical has been suggested by the site's history, or in which the chemical has been identified by other means. Colorimetric tubes are especially useful for chemicals that are not easily detected by the PID or FID, such as cyanides or carbon monoxide. One type of colorimetric tube available is the Draeger tube.

6.4.4 Electrochemical Gas Detectors

Electrochemical gas sensors detect toxic inorganic gases. One of the more common types of electrochemical sensors is the mixed oxide semiconductor. This detector is typically used for inorganic gases that are toxic at relatively low concentrations and cannot be reliably detected by other means. Because of the historical evidence at some of the SWMUs, specific detectors will be used for hydrogen cyanide. Electrochemical gas monitors that are set to give an audible alarm at the prescribed exposure limit for the chemical interest will be employed by the sampling crew during drilling and excavation.

6.4.5 Real-Time Aerosol Monitors

The real-time aerosol monitor is designed to monitor respirable particulates (< 10 microns). The instrument detects scattered electromagnetic radiation as airborne particles pass through a sensor. The response is converted to concentration units of milligrams per cubic meter (mg/m^3). The measurements can be useful if there are identified radionuclides, metals, PCBs, or other particulates such as asbestos present. Soil samples will be analyzed and the results will be used to determine action levels for the constituents that are present.

6.5 Personal Monitoring

Personal-exposure data will supplement the results of monitoring the ambient air. Monitors will be provided to field team members whose job functions make them likely to receive the highest doses. TLDs will be issued to field team members as a means of monitoring the radiation exposure of individual team members. Personal monitoring devices will be used as necessary for other materials identified during the course of the sampling efforts.

6.6 Air Samplers

High- and low-volume air samplers are available to measure ambient atmospheres and personal breathing zone concentrations of particulates, vapors, and gases. The selection of the samplers, collection media, and analyses will depend on the materials identified at the site. The samplers will be supplied by the contractor and approved by the Laboratory.

7.0 PERSONNEL PROTECTION AND SAFETY REQUIREMENTS

This section establishes the protective measures for site workers to be used during the OU 1148 RFI. These controls are categorized as engineering controls, work practices and PPE.

OSHA regulations state that, wherever feasible, engineering controls and work practices will be instituted to reduce and maintain employee exposure below the PEL. Engineering controls are mechanical means for reducing the hazards to workers; work practices are administrative controls minimizing exposure of field team members. If engineering controls and work practices are not successful in bringing exposure below permissible limits, PPE must be used. The OU 1148 investigation will employ a combination of these controls. Many of the potential contaminants at OU 1148 and their associated exposure limits are summarized in Table III-2.

7.1 Engineering Controls/Work Practices

7.1.1 Oxygen Deficiency

An oxygen deficient atmosphere is defined as an atmosphere in which oxygen by volume is less than 19.5%. Field team members will not be permitted to work in oxygen-deficient atmospheres. The most common means of restoring normal oxygen levels is ventilation. Ventilation can be achieved and maintained mechanically or naturally. Because of logistics in the field, mechanical devices may be difficult to use. Natural ventilation is effective but depends on current wind conditions.

Field team members will only be permitted to work in oxygen concentrations between 19.5% and 21%. Air purifying respirators will be worn during this work. Field team members will not work in oxygen-deficient or oxygen-rich atmospheres.

7.1.2 Fire/Explosion Hazards

Explosive or flammable atmospheres are defined as atmospheres in which the concentration of combustible vapors is greater than 20% of the LEL. Site workers will not be permitted to work in any area where this condition exists. Ventilation can be used to reduce the concentrations of explosive/flammable gases and will be used at OU 1148 where necessary.

An additional means of preventing explosion or fire is to ensure that no ignition sources are on site. Intrinsically safe devices will be used at all times.

Further guidance for handling flammable materials is available in Laboratory AR 6-5, "Flammable and Combustible Liquids"; and Laboratory TBs 601, "Flammable Liquids"; 602, "Flammable Gases"; 603, "Solvents"; and 604, "Epoxies." The ER Program SOPs will also be followed. Section 9.4 of the H&S Plan, requires a fire-and-explosion prevention-and-control program at sites with flammable and reactive materials.

Air-monitoring equipment will not detect the presence of HE or ordnance. According to Section 9.4 of the H&S plan, all field activities in areas potentially contaminated with HE and/or ordnance will be reviewed by University of Laboratory explosives-safety personnel.

7.1.3 Radiation Hazards

In any ER Program work involving areas of known or potential radioactive contamination, the OUPL and the site safety officer must prepare a work request specific to the site and submit it to HS-1 for review. If work is approved, HS-1 will issue a special work permit for radioactive work. The OUPL must obtain this permit before initiating work on site.

The primary methods for protecting field team members from radiation hazards are time, distance, and shielding. Both radiation-survey monitors and personal dosimeters will be used to track exposures of site workers over time. According to Section 8.0 of the H&S plan, administrative limits will be used to ensure that site workers do not exceed the quarterly or annual limits specified in DOE Order 5480.11 (DOE 1988, 0076). Restrictions will be placed on employees whose exposures have exceeded the allowable limits. Radiation levels will be maintained ALARA.

The action level for radiation is 1 mrem/h (EPA 1988, 0609). If this level is exceeded, field team members must evacuate the area to a distance at which radiation is at background level. The assistance of a radiation health physicist will be obtained before the site is re-entered.

Avoiding contact with contaminated materials and controlling contaminated dust are the most effective means of protecting individuals from contamination. However, the nature of the sampling process precludes total avoidance. Therefore, thorough monitoring and decontamination procedures will be the primary means of reducing radiation hazards.

7.1.4 Chemical Hazards

Chemical hazards are to be monitored during the performance of duties in the contaminated zone. If concentrations of toxic materials exceed the action limit (which is one-half the PEL or TLV), personnel will be removed from the area until natural or mechanical ventilation reduces the levels to background values.

Airborne dust and particulates pose two problems: nuisance dust, for which standards have been established at 10 mg/m^3, and the adsorption of hazardous substances on soil particles. During drilling or other activities that may generate dust, water can be sprayed in the area to suppress the dust. The effectiveness of dust-control measures will depend on the size of the area to be sprayed and the rate of evaporation of the water. Frequent applications may be required to achieve optimal results.

7.1.5 Corrosive Hazards

The most effective means of controlling exposure to corrosive hazards is to avoid contact with these materials. Although neutralizing the acids or bases in corrorsives is an ideal remedy for reducing the hazard, the choice of a neutralizing agent depends on the corrosive substance. Because corrosive materials in OU 1148 are likely to be unknown, engineering controls for corrosive materials are very limited. The pH of unknown corrosive materials must be determined so that an effective neutralizing agent can be identified.

7.1.6 Biological Hazards

7.1.6.1 Animals/Insects

Site workers may potentially be exposed to a variety of snakes, insects, and rodents. For example, rattlesnakes may be encountered in some cracks or ledges near the canyon walls. Site workers should avoid high grasses as much as possible. If field team members need access to these areas, they will wear snake leggings.

Insect repellents can be used to control bites from some insects; however, field team members should also be aware that repellents may affect sample analyses. Field team members will check for ticks after working in grass and wooded areas.

Controls for exposure to rodents are limited. Workers should be aware of potential habitats for rats and mice. If an individual is bitten by a rodent, the animal should be

captured, if possible, to be tested for rabies, and the victim should be transported to a medical facility.

7.1.6.2 Poisonous Plants

Field team members should be trained to identify poisonous plants, such as poison ivy (Toxicodendron radicans), death camas (Zigadenus spp.), water hemlock (Cicuta doughlasii), and poison hemlock (Conium maculatum) before field work begins. Contact with these plants will be avoided and no wild plant will be eaten. If these plants are present at the sampling location, they will be cleared in an appropriate fashion.

Poison Ivy (Toxicodendron radicans)

Poison ivy contains a toxic oil (urushiol) that causes painfull swelling and eruptions on the skin after external contact. Sensitivity varies between people. Cases of severe reaction should be treated by a physician.

Poison ivy is usually found in moist habitats such as canyon bottoms. It is recognized by its deep green, shiny trifoliate leaves that have distinct, irregularly sized teeth along the margins. The leaf shape may resemble box elder, a common tree in the canyons near Los Alamos. The plant bears white or yellowish white berries.

Death Camas (Zigadenus spp.)

Death camas contains a toxic substance, zygadenin, that can cause serious illness or death when ingested. If poisoning is suspected, medical help should be sought immediately.

Death camas is found in the mountains of northern New Mexico, in pinon-juniper woodlands or pine forests. It is a small plant, typically less than 2 ft in height, and resembles a wild onion in that the long, grass-line leaves originate from an underground bulb. When in bloom, its small, lily-like flowers are greenish white and typically arranged in branching clusters along a central stalk. The most common cause of poisoning is mistaken identification with wild onions. The bulbs of the death camas do not have an onion-like odor.

Water Hemlock (Cicuta douglasii)

Water hemlock contains a toxic substance, cicutoxin, that affects the central nervous system of mammals when ingested. Symptoms of poisoning include vomiting, colicky pains, staggering, unconsciousness, and convulsions. Severe cases can be fatal, and no antidote is known. Immediate medial attention should be sought if this plant is ingested.

Water hemlocks are found in wet ground and along streams. They are tall plants, reaching 6 ft in height, with longitudinal ribs on the stem. The leaves are one- to three-times pinnately divided. The leaflets are coarsely toothed, with the lateral

veins ending between the teeth. The small white flowers are arranged in umbels at the top of the plant (similar to the flower arrangements of carrots, parsley, and dill).

Poison Hemlock (Conium maculatum)

Poison hemlock is highly toxic when ingested. Suspected poisoning should receive immediate medical attention. Ingestion of water hemlock or poison hemlock is often the result of mistaking the plant with the many edible members of the same plant family including celery, carrots, parsley, dill, cilantro, anise, cumin, and fennel.

Poison hemlock is found in damp ground, near streams, and occasionally on moist slopes. The plants may be as tall as 10 ft with stout, sometimes branching stems. The stems are longitudinally ribbed and have purple spots or streaks near the base. The leaves have multiple pinnate divisions, and resemble celery leaves. The small white flowers are arranged in umbels at the top of the plant and the ends of the branches.

7.1.6.3 Infectious Agents

If the sampling area is littered with debris such as sharp objects, broken glass, and items with jagged edges, field team members will clear it before proceeding with work. Cuts, abrasions, and puncture wounds will be treated immediately by an individual certified in first aid. Medical personnel will be consulted in the case of severe wounds and will determine the necessity for tetanus inoculation.

7.1.6.4 Hygienic Practices

Contact with potentially-biologically contaminated materials will be avoided. Hygienic practices will be observed on site at all times. Eating, drinking, smoking, chewing gum or tobacco, and applying makeup or lip balm will be prohibited on site. Field team members must wash their hands and faces upon leaving a contaminated area as well as before drinking, eating, or smoking. These practices are consistent with Section 9.4 of the H&S plan.

7.1.7 Physical Hazards

This section outlines the controls necessary to reduce the severity of the physical hazards listed in Section 7.5.1.7 of this H&S plan.

7.1.7.1 General Physical Exposures

Failure of field project management staff and site workers to recognize, evaluate, and control site hazards can result in exposure to contaminants by means of skin contact or inhalation, burns, blow-outs, slips, trips, and falls, and other hazards. The project's goal is to avoid accidents completely.

Pinch points are associated with activities using equipment with turning or moving parts such as drill rigs, backhoes, and some hand tools. Machinery and equipment, along with their operating procedures, should be reviewed in advance so that pinch points can be identified. The potential for pinch points or entanglement is reduced by installing guards to shield moving parts. Field team members must ensure that guards are in place before operating the equipment. If guards have been broken, worn, or removed, the tool or equipment should be tagged and remain out of service until the guard has been replaced. The site safety officer will be responsible for maintaining a check list for inspection purposes. OSHA requires most equipment to be inspected annually. This inspection is typically conducted by the manufacturer, representative, or dealer. Documentation of inspections must accompany the equipment at all times.

Potential physical exposures will be identified and evaluated for consistency with Laboratory and OSHA requirements. Physical exposures will be reduced to an acceptable level through engineering and work practice controls to the extent feasible. Additionally, personnel shall be properly protected in a manner consistent with Laboratory and OSHA requirements concerning PPE. PPE will be provided to effectively eliminate potential for skin contact, and to reduce potential inhalation to less than the PEL.

The minimum protection for any person who enters the job site consists of

- a hard hat;
- safety glasses with side shields or goggles;
- appropriate work clothing, including shirt with long sleeves and durable long-leg pants such as jeans;
- gloves whenever materials are being handled: chemical resistant gloves whenever there is a potential for contact with site contaminants (i.e., residue), and cotton gloves when performing manual tasks such as loading and unloading supplies or handling or moving equipment and materials;
- steel-toed safety shoes of leather or a chemical-resistant material; and
- disposable booties in MDA G.

All PPE will conform to OSHA standards.

Field team members will work together to establish and maintain site control. Field management will prohibit entry to the work area to personnel who lack the minimum acceptable training and medical and safety equipment as specified in the ER Program SOPs which conform with the requirements of Title 29 CFR Part 1910.120 (OSHA 1991, 0610).

Chemical and physical hazards associated with this project will be eliminated as much as possible by engineering controls before work begins. These controls will include, as appropriate, barricading, guarding, posting signs, and verbally warning

site personnel. None of the planned operations is inherently dangerous when performed by trained and experienced personnel working under safe conditions. The work crews will endeavor to maintain good working conditions through organization and through recognition of hazards before they result in injury and loss. Laboratory SOPs provide guidance to employees executing specific operations. Where possible, all field team members will recognize, evaluate, and control physical hazards.

7.1.7.2 Noise

Hearing protection will be worn in areas where noise levels are suspected or shown to exceed 85 dBA. Field managers will be responsible for identifying areas with high noise levels (continuous or intermittent) and on-site personnel will wear hearing protection devices in these areas. Warning signs will be posted.

7.1.7.3 Working In Confined Spaces

All systems to be entered will be locked out/tagged out and electrically and/or mechanically de-energized, lines entering and leaving will be broken/blanked off, and appropriate signs and personnel (safety watch) will be posted before any entry.

All workers entering confined spaces will have received prior training in confined-space procedures (LANL AR 8-1). The space will be evaluated and cleared by a designated "qualified person." The qualified person will have had training in confined-space procedures, supervised field training in the evaluation of confined spaces, and experience in conducting confined-space evaluations.

An initial hazard assessment will be conducted that includes atmospheric testing for oxygen deficiency, flammable gas concentration, toxic contaminants, and physical hazards. No entry will be made unless the oxygen concentration is between 20 and 22%; the flammable gas concentration is less than 10% of the LEL; the toxic contaminants concentrations are less than half of the PEL; and physical hazards are controlled by engineering or administrative methods or by PPE.

Communication procedures will be established and reviewed between persons entering the space and the outside standby crew member before entry. A tailgate safety meeting with all crew members will be conducted before entry. Chemical, physical, and confined-space hazards that require PPE and emergency response procedures will be addressed.

Placing passive air-sampling devices over the canyon edge is considered to be working in a confined space. A qualified person will be required to rig the work for this activity.

7.1.7.4 Working around Potentially Energized Electrical Equipment

All electrical tools and equipment used will be Underwriters-Laboratory (U-L) approved for the potential hazards existing at the location at which the equipment will

be used. Electric tools and equipment shall be double insulated. All electrical connections shall be made through a ground fault circuit interrupter (GFCI). Fire extinguishers will be kept in sufficient number and locations to allow site personnel to extinguish minor fires.

Each electrical connection or electric wire will be treated as live. Electric equipment and wires will not be touched with wet hands or by a person standing on a wet surface. Electric cords will be disconnected from the outlet by grasping the plug, not by pulling or jerking the cord. Electric wires, extension cords, light cords, conduits, etc., will be located so that they cannot be tripped over, walked on, or otherwise damaged by pedestrian or other traffic. Extension cords will be protected from damage by routing them overhead and away from traffic areas. Electric tools and equipment will be kept from fuel sources, especially flammable liquids.

Drilling, trenching, and sampling activities may involve the potential for electrical shock. The source of this hazard may be from overhead and underground utilities, use of portable equipment, and digging or hand auguring into underground utilities. Guidance for electrical shock hazards is available in the ER Program SOPs. In addition, the following practices will decrease the potential for shock:

- only qualified and licensed personnel will be permitted to operate this equipment;
- heavy equipment and energized tools will be inspected by a competent person before use and will meet all applicable local, state, and federal standards;
- while in use, drill rigs will maintain a 35 ft minimum distance from overhead power lines, and in transit with the boom lowered, the closest approach to a power line will be 16 ft;
- all areas to be drilled will be cleared through the Laboratory utilities manager before drilling begins;
- any cord with the grounding stem removed will be taken out of service and repaired or discarded; and
- GFCIs will be used on all portable electrical equipment.

7.1.7.5 Working around Heavy Equipment and Machinery

All heavy equipment will have a functioning back-up alarm. This alarm must be capable of producing sound at a frequency and intensity sufficient to overcome background noise and to be clearly audible to employees wearing hearing protection. Heavy stationary equipment will be barricaded at a distance from ground personnel sufficient to avoid swinging cabs, counter weights, and booms.

The number of passengers in a vehicle will not exceed the number of functional seat belts available. Seat belts will be used at all times. Personnel will not ride on or in

vehicles or equipment in a manner not designated for the conveyance of people. All equipment will be used in the manner for which it was intended. Drivers will operate the equipment in accordance with the manufacturer's instructions and in adherence to federal, state, and local regulations.

Weights for all items lifted shall be calculated before lifting. The boom angle, cable, and auxiliary lines will be determined to have a rated-load margin of at least 20% greater than the weight of any lift. All rigging material used for a particular lift will represent a 50% margin of lift capability greater than the weight of the particular load.

Signaling the operator of a crane will be accomplished by means of hand signals rather than radio. All heavy equipment will carry at least a 5 lb multipurpose dry-chemical fire extinguisher.

A hazard associated with drilling is the potential failure of the wire rope. If the rope breaks under tension, it may cause severe injuries. The wire rope and its related parts will be included in the inspection program.

7.1.7.6 Housekeeping

Work areas will be kept sufficiently clean and orderly so that work activities can proceed efficiently and safely in a manner that will produce and maintain safety and quality. They will be adequately lighted, ventilated, protected, and accessible as appropriate for the work being performed. Machinery and equipment will be arranged and stored to permit safe, efficient work activities and ease in cleaning. Tools and accessories will be safely stored out of traffic areas.

Sufficient waste containers and receptacles will be provided in appropriate locations and emptied frequently and regularly. Work areas and floors will be maintained free of debris, obstructions, foreign materials, or slippery substances such as oil, water, and grease.

Aisles, traffic areas, and exits will be maintained free of materials and debris. Combustible materials will be stored in approved containers and disposed of properly. Waste rags will be stored in metal containers. All flammable liquids will be stored in safety cans. Dangerous materials will be stored outside of the work area.

Site workers are held accountable for keeping their work areas free of housekeeping hazards.

7.1.7.7 Use Of Mechanical and Flame Cutting Equipment

Cutting, welding, or similar operations that produce heat, sparks, or open flames will be isolated from any potential combustible source. The area surrounding the activity will be inspected to ensure that no combustible materials are close by, or, if they are, and they are impractical to remove, that they are shielded or otherwise protected.

Oil- and grease-free clothing will cover the entire body. Flame-retardant -resistant aprons, vests, leggings, capes, and gauntlet gloves will be worn as appropriate.

Collars and cuffs of shirts and jackets will be buttoned and pants cuffs will be turned up inside. Pockets will be eliminated or have button flaps. Welding helmets will have the proper shade of welding lens. Safety goggles or spectacles with tinted lenses will be worn under the welding helmet.

Sufficient ventilation will be provided in the welding or cutting area. Shields will be placed to protect other workers from welding-arc rays. A fire extinguisher will be assigned to the welding area.

7.1.7.8 Materials Handling

Gloves will be worn whenever material is lifted. Two or more workers may be required to lift a heavy or bulky item. A firm grip on material being moved and secure footing when lifting or handling a load is required. Fingers and toes should be in the clear before the item is set down. Material must be transported and stored in a stable manner to prevent falls, rolls, or slips. The movement of a long object must be controlled when it is carried through congested areas, on stairways, in passageways, or around blind corners. Pinch points should be avoided.

Whenever practical, a heavy item should be handled by mechanical or powered equipment. Workers should stay clear of material-handling equipment and the load being transported.

7.1.7.9 Temperature Extremes

High temperatures require personnel to be closely monitored for signs of heat exhaustion or heat stroke. Shaded areas and cool water will be provided.

In the winter, personnel must be protected from the effects of cold temperatures and wind as well as from becoming wet during field operations.

The field management staff will evaluate personnel and operations throughout each day for impact of exposure to the elements. Special care will be taken during the first days of operation to allow site workers to become acclimated.

One or more of the following control measures can be used to help control heat-related disorders:

- Providing adequate liquids to replace lost bodily fluids. Employees must replace water and salt lost from sweating; therefore, employees must be encouraged to drink more than the amount required to satisfy thirst. Thirst satisfaction is not an accurate indicator of adequate salt and fluid replacement. Replacement fluids can be a 0.1% salt water solution. Commercial fluid- and nutrient-replacement beverages are also effective.

- Establishing a work regimen that will provide adequate rest periods for cooling down. This may require additional shifts for workers.

- Using cooling devices, such as Vortex tubes or cooling vests, to be worn beneath protective garments.

- Informing all employees of the importance of adequate rest, acclimation, and proper diet in the prevention of heat stress. All breaks are to be taken in a cool rest area (77° F is best).

Procedures for recognizing and avoiding cold stress must be implemented when the ambient temperature is less than 40° F.

If cold-stress symptoms are observed, move the patient to a warm, dry place and remove any wet clothing. If the patient is conscious and alert, give the patient warm liquids, but no caffeine. Warm the patient's affected extremities with moist, lukewarm compresses; gradually increase the patient's temperature until normal circulation and temperature return. Seek medical attention for all but minor cold-stress cases.

7.1.7.10 Excavations

All excavations will be performed from a stable-ground position. A person trained in excavation safety will make daily inspections of the excavation. The inspector will determine the likelihood of cave-in, and remedial action, such as sloping or shoring, will be taken if the walls appear to be unstable.

All soil will be at least 2 ft from the edge of the excavation to prevent it falling back into the excavation. Barricades or caution tape will enclose the excavation on all sides at least 2 ft from the edges.

All field team members will participate in the daily tailgate safety meetings and will be instructed on the following requirements:

- Before excavating, the existence and location of underground pipes, electrical equipment, and gas lines will be determined. This will be done, if possible, by contacting the appropriate utility company and/or client representative to mark the location of the lines. If the client's knowledge of the area is incomplete, an appropriate device, such as a cable-avoiding tool, will be used to locate the service line.

- No ignition sources are permitted if the ambient airborne concentration of flammable vapors exceeds 10% of the LEL during excavation. A CGI will be used to make this determination.

- Operations must be suspended and the area vented if the concentration of airborne flammable substances reaches 10% of the LEL in the area of an ignition source (i.e., internal combustion engine exhaust pipe.)

- Combustible gas readings of the general work area will be made regularly.

- If excavating equipment is located near overhead power lines, a distance of 15 ft must be maintained between the lines and any point on the equipment. If the lines have appreciable sag or if windy conditions exist, this distance shall be 20 ft.

Trenches within the OU 1148 SWMUs must be excavated to a depth of less than 5 ft whenever possible. Trenches with depths greater than 5 ft require protective systems such as sloping, benching, or shoring. In addition, trenches at depths of 4 ft or more must have a means of egress available every 25 ft. The air in the trench must be monitored. Soil piles, tools, and other debris must be stored at least 2 ft from the edge of the excavation. All excavations must be marked to restrict access when the area is not occupied. Field team members must be aware of conditions inside the trench as well as of any activities taking place outside the excavation.

7.1.7.11 Underground Hazards

Field management must take any steps necessary to ensure that all underground utilities have been located and that all utilities to the site area have been neutralized.

Additionally, drilling and digging operations will progress only if field management has reasonable assurance that objects, utilities, product lines, and other obstacles in the excavation have been identified and located. A magnetometer or similar device will be employed to assist in identifying subterranean hazards that are not adequately identified by other means. Drillers will dig the first 3 ft of postholes manually before inserting the drill auger. These measures should minimize the potential of encountering buried physical hazards.

If unmapped or unneutralized utilities are discovered or encountered during drilling and digging, work will stop immediately and will not resume until the hazard has been eliminated.

The various manholes, ventilation pipes, and entrances to below-ground areas represent hazards to personnel and vehicles traveling across the site. All of these hazards will be marked with stakes and warning tape as necessary to prevent personnel and equipment from standing on or driving over manholes or running into vertical vent pipes. Open manholes or similar openings will be effectively roped off or barricaded.

Excavation and digging activities will comply fully with Laboratory ER Program SOPs and permits will be correctly completed and posted before any excavation or drilling operation begins.

7.1.7.12 Traffic

Traffic control will be maintained in and around the job site at all times to avoid personnel injuries and prevent equipment damage. So that equipment operaters will not run into pedestrians or workers, work areas will be delineated by barricades, warning signs, warning lights, traffic cones, and so forth. Personnel will wear

fluorescent orange and/or reflective clothing, vests, etc., when working in and around traffic areas.

Sufficient parking will be provided. Vehicles not being actively used will be parked so that they do not interfere with traffic. When a vehicle is being maneuvered in a confined area with limited visibility, personnel positioned outside the vehicle will assist the operator.

Pedestrians have the right-of-way. When working around heavy equipment, ground personnel should always make eye contact with operators of moving vehicles and wait for a signal to proceed before passing close to or in front of operating equipment.

All drivers and operators will adhere to speed limits, signs, and road markings. Equipment operators and ground personnel will be especially careful when air-line respirators are in use because of the potential for injury if an air line were to become tangled in the track or wheel of a vehicle or other piece of equipment. Under no circumstances will systems supplying air to the respirators of ground employees be attached to vehicles or equipment.

7.1.7.13 Compressed Gases and Systems

Compressed gases will be used according to the supplier's instructions, Compressed Gas Association guidelines, and the requirements of this H&S plan. Additionally, these gases will be used in a manner that precludes human exposure.

Compressor hose segments will be secured using chains and/or locking pins. In addition, the pressurized hose will be connected to the compressor through a pressure-sensing device that will discharge the pressure if the pressure system fails (i.e., if the hose is cut).

Personnel are required to wear safety glasses and gloves when handling and hooking up compressed-gas cylinders or systems.

7.1.7.14 Breaking Concrete

Continuous real-time air monitoring must be provided throughout the operation. Controls will be used as necessary to establish and maintain an acceptable level of exposure to concrete dust. If monitoring is inconclusive, provide PPE to exposed employees.

The operation will be kept wet to reduce dust. Eye, face and respiratory protection must be used as necessary. Eye and face protection includes goggles, safety glasses with side shields, and/or a face shield that extends past the throat and attaches to a hard hat.

Hearing protection will be used as required. If earplugs do not offer enough protection, earmuff-type hearing protectors and plugs will be used.

To combat the damaging effects of jackhammer vibration, good rubber hand grips and gloves that are padded to absorb the vibration will be used. Low-back protection, such as a belt designed for this purpose, will be required.

Pressure hoses supplying jackhammers will have a conductive pressure hose to limit the potential for electrical shock injuries to personnel in the event an active electrical source is unexpectedly encountered.

7.1.7.15 Topography

To reduce hazards associated with topography, the site safety officer will inspect each site for potential hazards. Some of these hazards can be alleviated by removing any obstacles in immediate work areas, clearing icy surfaces, and placing tools in an accessible but protected area. Boundaries surrounding excavations, trenches, and boreholes will be marked. Field team members conducting site activities near the edge of a mesa will not be permitted to work closer to the edge than 5 ft. Barrier tape will be used to designate this restricted area. Two exceptions to this requirement are sampling of outfall and the placement of passive air-monitoring devices. In these instances, the worker will be tied off before descending over the edge or proceeding beyond the barrier tape. All field team members will be informed of the potentially hazardous locations as well as of the controls. Field team members will also be expected to observe good housekeeping practices for the duration of the work in each area.

7.1.7.16 Lightning

Lightning strikes the tallest object in an area and takes the fastest route into the ground through the best conductor; therefore, buildings or vehicles provide better protection than being in the open. A large building with a metal structure is the safest because electric current will run along the outside metal frame and into the ground. An automobile with a metal roof serves the same purpose; however, convertibles or fabric-topped cars are not safe because lightning can burn through the fabric.

Wood or brick buildings that are not protected by lightning rods have high potential for conducting a strike, which travels down natural conductors such as wiring or pipes. Any contact with an ungrounded conductor can be dangerous. Telephones, faucets, electrical equipment, and metal fences are examples of ungrounded conductors.

A person in the open during a lightning storm should crouch to avoid being the tallest object. A tingling sensation or hair standing on end signal that lightning is about to strike and that a crouching position must be assumed immediately. The safest crouching position is to place the hands on the knees and keep the knees and feet together while remaining as low as possible. Stretching out flat on damp soil could cause the body to attract current running into the ground from a nearby tree. Keeping feet and knees spread or placing the hands on the ground could complete a circuit and cause high-voltage current to run throughout the body.

A grove of tree affords more protection than remaining in the open or taking shelter under a single tree. Lower ground is also safer, however, ditches and ravines present the danger of flood waters.

Side strikes injure more people than direct strikes. Side strikes occur when electric current jumps from its present conductor to a more effective conductor. The human body is a better conductor than a tree trunk; therefore, a person should stay 6 ft from a tree to avoid a side strike. A group of people taking shelter under a grove of trees should stand 6 ft apart to avoid side strikes from one person to another.

The force of electrical current temporarily disrupts the nervous system; therefore, even if breathing and heartbeat have stopped, a lightning victim may not be dead. Many victims can be revived by artificial respiration and CPR. Current is no longer running through the body once the lightning flash is over; therefore it is safe to touch a lightning victim. Even a victim who seems only slightly stunned should receive immediate medical attention because internal organs may be damaged.

7.2 Personal Protective Equipment (PPE)

If engineering controls and work practices do not provide complete protection against hazards in OU 1148, field team members will be required to use PPE. PPE shields or isolates individuals from chemical, physical, biological, and some radiological hazards that may be encountered on site. PPE protects the respiratory system, skin, eyes, face, hands, feet, head, body, and ears. Two important criteria for selecting this equipment are the potential hazards on site and the type of work to be performed. Hazards associated with the equipment, such as reduced mobility, dexterity, vision, communication, and increased heat stress, should also be considered. Field team members must be able to communicate when wearing hearing protection.

The EPA has established four levels of protection for workers involved with potentially hazardous materials on the basis of the degree of dermal and respiratory protection appropriate to the hazards at the site. Level A consists of maximum dermal and respiratory protection through the use of a fully encapsulating suit and air-supplying respirator. Level B maintains the maximum respiratory protection with a downgrade in dermal protection. Level C provides respiratory protection through an air-purifying respirator (APR). Level D is a basic work uniform.

Further information on the components of Levels A, B, C and D, and the selection criteria and limitations of each are presented in the following text. Respiratory protection OU 1148 investigations will be conducted according to Laboratory AR 12-1, "Personal Protective Equipment"; Laboratory Technical Bulletin (TB) 1201, "Eye and Face Protection"; TB 1202, "Protective Clothing"; TB 1203, "Respiratory Protective Equipment." In addition, in accordance with the ER Program SOPs, the site-specific special work permit for work in radioactive areas will specify the appropriate protective clothing and equipment to be used on sites with known or suspected radioactive contamination.

7.2.1 Selection of PPE

This section details PPE to protect field team members from the hazards discussed within this H&S plan. PPE required at individual OU 1148 SWMUs depends on the types of work to be conducted and the known, suspected, or unknown contaminants present. Table III-1 lists the required levels of protection for each SWMU.

Selection of the appropriate PPE is a complex process that takes into consideration a variety of factors, including identification of the hazards or suspected hazards and their routes of transmission to employees (inhalation, skin absorption, ingestion, and injection), and the performance of the PPE materials (and seams) in providing a barrier. The amount of protection provided by PPE varies: the materials used in protective equipment will protect well against some hazardous substances and poorly, or not at all, against others. In many instances, materials that will provide continuous protection from a particular hazardous substance cannot be found. In these cases, the time it takes for the material to show signs of wear should exceed the time the PPE is in use.

In some cases, layers of PPE may be necessary to provide sufficient protection or to protect expensive PPE inner garments, suits, or equipment. As more information about on-site hazards and conditions becomes available, the field team leader can make decisions to upgrade or downgrade the level of PPE to match the tasks at hand.

The following are guidelines that the field team leader can use to determine the selection of the appropriate PPE; however, they do not fully address the performance of the specific PPE material in relation to the specific hazards at the job site. PPE selection, evaluation, and reselection is an ongoing process until sufficient information about the hazards and PPE performance is obtained.

7.2.1.1 Level A Protection

Level A protection is worn when a hazardous substance has been identified that requires the highest level of protection for the skin, eyes, and respiratory system on the basis of a measured or potential high concentration of atmospheric vapors, gases, or particulates; site operations and work functions that involve a high potential for splash, immersion, or exposure to unexpected vapors, gases, particulates, or materials that are harmful to the skin or capable of being absorbed through the skin; the known or suspected presence of substances with a high degree of hazard to the skin where skin contact is possible; or operations being conducted in confined, poorly ventilated areas.

(NOTE: Level A protection will not be worn during the OU 1148 field investigation; therefore, no description of Level A PPE is given).

7.2.1.2 Level B Protection

Level B protection will be specified for situations requiring self contained breathing apparatus (SCBA) and for situations in which the identity and quantity of contaminants is unknown. SCBAs will be used when

- oxygen levels are less than or equal to 19.5%;
- chemical concentrations exceed the PEL;
- the chemicals of concern do not have adequate warning properties;
- cartridges/canisters are not available for the chemicals and/or concentrations of concern; or
- the identity of the contaminant is unknown.

Level B protection will consist of the following:

- a full-face, positive-pressure SCBA (Mine Safety and Health Administration [MSHA]/NIOSH-approved);
- contaminant-resistant clothing such as Saranex or polyvinyl chloride (PCV) for dust and splash protection against chemicals of concern;
- inner gloves of latex surgical material;
- outer gloves of rubber, PVC, or nitrile, depending on suspected contaminants;
- rubber steel-toed safety boots with disposable boot covers when necessary;
- a hard hat for protection from overhead hazards, with a hood for splash protection; splash shields are optional, depending on activity and conditions; and
- hearing protection when the noise level exceeds 85 dBA.

The field team leader is responsible for ensuring that workers adhere to the recommended level of PPE and may upgrade or downgrade the level of protection as additional information about site hazards becomes available.

7.2.1.3 Level C Protection

Level C protection will be considered in instances where a known chemical contaminant has exceeded the specific PEL. An APR will be selected if the following criteria are met:

- oxygen levels are greater than 19.5%;
- chemical concentrations do not exceed the Immediately Dangerous to Life and Health (IDLH) levels;
- the chemical has adequate warning properties; and

- cartridges and canisters are designed for the chemicals and concentrations of interest.

Level C protection will include the following:

- full-face APR (MSHA/NIOSH-approved) with combination organic vapor/ particulate cartridges or canisters capable of filtering out the chemicals of concern;
- contaminant-resistant clothing made of such material as Saranex or PVC, for dust and splash

Protection against chemicals of concern;

- inner gloves of latex surgical materials;
- outer gloves of rubber, PVC, or nitrile, depending on suspected contaminants;
- rubber steel-toed safety boots with disposable boot covers when necessary;
- leather safety boots with disposable boot covers;
- hard hat for overhead hazard protection (splash shields are optional depending on activity and conditions);
- hearing protection when the noise level exceeds 85 dBA; and
- escape mask for respiratory protection in the event of a release or of respirator failure

7.2.1.4 Level D Protection

Level D protection can be used when the air contains no known hazard and when work will not result in unexpected inhalation of or contact with hazardous levels of any chemicals.

Level D protection will consist of the following:

- cotton or Tyvek coveralls;
- rubber, PVC, or nitrile outer gloves for protection against chemicals and particulates;
- leather gloves for abrasion protection;
- steel-toed safety boots for puncture/crush protection;
- optional boot covers for dusty or muddy conditions;

- hard hat with optional splash shield for protection from overhead splash hazards;
- safety glasses with non removable side shields for splash and particulate protection;
- hearing protection (earplugs or earmuffs) if the noise level exceeds 85 dBA; and
- escape mask for respiratory protection in case of an unexpected release from which escape is necessary.

7.2.2 PPE for Task-Specific Hazards

The guidelines given in this section apply to all work performed in OU 1148. Specific H&S considerations for the activities conducted under the SAPs in Section 4.0 of this work plan are discussed in the following text. Levels of protection for activities at each SWMU are outlined in Table III-1.

7.2.3 Field Surveys

The field surveys (non-intrusive) for the SWMUs within OU 1148 may be performed in Levels B, C, or D, depending on the hazard potential. The emplacement of passive air monitors, surface water runoff sampling, sediment sampling, and high-volume air-monitoring devices may be performed in Level D protection.

Level D protection will be worn for most surface soil sampling work unless there is an unknown contaminant; then Level C or B will be worn. Level C respiratory protection will include both organic vapor and particulate cartridges. Leather gloves may be used to protect skin from constant friction when using equipment that could cause blistering of the hand. The sampling effort may involve drilling through asphalt or concrete. Under these circumstances, site workers will wear dust masks, hard hats, safety glasses, protective shields, and hearing protection when necessary.

7.2.4 Surface Sampling

Surface sampling will involve collecting surface-water run-off and soil or sediment samples from the first 12 in. of soil. Site workers may wear Level D protection, depending on the specific site conditions. Safety harnesses will be used by any member who will be working at the edge of the mesa. Under extremely dusty conditions, site workers will take measures to suppress the dust by watering down the area of work. The appropriate air monitoring must be performed.

7.2.5 Subsurface Sampling

The subsurface sampling program comprises a variety of activities that will involve drilling and excavation. Field team members will wear Level B protection during this activity until the situation meets the criteria for Level C protection. Regardless of the level of protection in use, field team members will wear gloves, safety boots, hard hats, and eye and ear protection, as required, during drilling operations.

Air monitoring for oxygen, and flammable or toxic gases will be performed before drilling and excavating begin, especially in low-lying areas. Continuous monitoring for flammable or toxic gases will be conducted at the borehole during drilling or coring. Excavation or trenching operations will be monitored where soil is being disturbed. Completed excavations and trenches will be monitored periodically for oxygen and flammable or toxic gases.

The field team leader is responsible for selecting the appropriate level of protection on the basis of the air-monitoring information. The initial levels of protection for these activities are discussed in the following paragraphs.

The level of protection for drilling the boreholes will depend on the type of SWMU. Level B protection will be used for the initial coring in the surface impoundments and trenches, because of the potential for release of known and unknown hazardous materials. An electrochemical monitor will be worn by the sampling team to detect the potential presence of hydrogen cyanide. Once the installations are complete, the levels of protection may be downgraded if conditions permit.

Sampling septic tanks and within septic system drain fields can be performed in Level C protection unless air monitoring results indicate otherwise.

Table III-1 lists required levels of protection for each of the SWMUs.

7.3 Hazard Communication

In accordance with the provisions of 29 CFR Part 1910.1200 (OSHA 1991, 0610) that implement right-to-know legislation, site workers must be informed of potential hazards associated with a site before commencing work activities. The following sections describe the provisions for hazard communication to be observed during work in OU 1148.

7.3.1 Safety Meetings

Pre-entry briefings will be held before initiating any site activity and any visitors who will enter OU 1148 are expected to participate in briefings. Safety meetings and safety inspections will also be conducted to ensure that the H&S plan is being followed.

7.3.2 Employee Information

The site safety officer will ensure that the following DOE and Laboratory forms are posted where field team leaders and field team members can easily read them:

- Form F 5480.2, Occupational Safety and Health Protection;
- Form F 5480.4, Occupational Safety and Health Complaint Form;
- Laboratory Special Work Permit; and
- OSHA Job Safety and Health Protection Form.

The Laboratory H&S standard concerning employees' right-to-know will be posted at the work site. Employees will be required to sign the Acknowledgement of On-Site Briefing Form before the initiation of field work activities.

7.3.3 Material Safety Data Sheets

Material Safety Data Sheets (MSDSs) describe the chemical/physical properties, exposure information, toxicological effects, and appropriate protection for chemicals used in the course of site work. The site safety officer will be responsible for obtaining the necessary MSDSs (at a minimum, for the hazardous constituents listed in Table III-2), and attaching them to this H&S plan.

8.0 SITE CONTROL

The objectives of site control are to protect employees and the general public from exposure to hazardous substances and conditions and to prevent the spread of contamination. Site control entails the establishment of boundaries on the basis of the nature and extent of contamination at the site as well as on safe access. Three general areas will be defined in this H&S plan: the exclusion zone, the contamination-reduction zone (CRZ), and the support zone. Site access issues are also addressed in Section 7.0 of the IWP, Annex III, H&S Plan (LANL 1991, 0553). Maps showing the location of these zones will be prepared prior to the start of field work (drilling).

The field team leader and/or the site safety officer will walk the intended job site before the start of work. During the site walk, the following tasks will be accomplished:

- Determining how to best implement the H&S plan (e.g., set up zones, establish site control, and place decontamination area(s), etc.) and whether variances must be made to the plan. If variances are necessary, the requirements in Section 2.4 of this H&S plan will be followed.
- Defining the job site, work to be done, and potential H&S impacts. Information gathered during the initial site entry and the guidelines of the

H&S plan will be used to determine if changes need to be made in personnel protective protocols (e.g., levels of protection).

- Assessing the work area and vicinity, especially noting areas, equipment, material, and conditions that can result in H&S hazards. Special priority will be given to identifying all suspected conditions that may pose inhalation or skin-absorption hazards that are IDLH, and other conditions that may cause death or serious harm. Examples of such hazards include confined spaces, potentially explosive or flammable situations, visible vapor clouds, or the presence of biological indicators such as dead animals or vegetation. During this assessment, the site safety officer, or a qualified designee, shall carry appropriate real-time air-monitoring equipment (i.e., PID, Draeger tubes, LEL/oxygen meter, etc.) capable of detecting air-borne concentrations of potential site contaminants at their respective PELs and other hazardous (i.e., flammable/oxygen-deficient) atmospheres.

- Assembling information for the first day's tailgate safety meeting (pre-entry briefing).

The field team leader and the site safety officer will use the information furnished by the results of air monitoring with direct reading instruments and observation/testing of the soils and sediments collected from boreholes and excavations to ensure continuing site control.

8.1 Exclusion Zone

The exclusion zone is the area inside the SWMU in which contamination does or could occur. Due to the types of areas in which OU 1148 SWMUs are located, the implementation of boundaries for the exclusion zones will vary. The designation of the exclusion zone for each SWMU depends on the following factors:

- number and distribution of the sampling locations;
- types and amounts of contaminants expected (including HE);
- air-monitoring results;
- use of mechanical equipment/heavy equipment (including drill rigs and backhoes);
- proximity to overhead and underground utility lines; and
- topography.

Access to the exclusion zone will be restricted to field team members who have direct responsibilities for sampling in this area and are wearing the appropriate PPE. Different zones with different levels of protection requirements can be established within the exclusion zone, if necessary.

The hotline is the outer boundary of the exclusion zone. Depending on the location of the SWMU (i.e., isolated areas versus residential or commercial), the hotline will be marked in the most appropriate fashion. Fences, barrier tape, or signs can be used depending on the circumstances.

8.2 Contamination Reduction Zone (CRZ)

The CRZ is the transition area between the contaminated area and the clean area. This zone serves as a buffer and prevents further spread of contamination from the site by providing a specified area for decontamination activities.

The CRZ will be upwind of the exclusion zone, if possible. The outer boundary of the zone is the contamination-control line, which be indicated accordingly. Because of the potential presence of contamination in this area, support workers at the contamination-control line will wear the appropriate level of protection.

8.3 Support Zone

The support zone is the location of administrative and other support functions. This zone will also be upwind of the exclusion zone, if possible. Personnel do not have to wear PPE in this area.

8.4 Site-Control Procedures

To promote adequate site security, personnel safety, and smooth operation of the site activities, the following measures will be instituted as necessary:

- All information regarding work to be performed, emergency procedures, and H&S hazards will be reviewed at a daily tailgate safety meeting. This meeting will occur before work begins.
- A copy of this plan will be available at the job work site.
- Only authorized personnel will be permitted in the work area. These individuals must have successfully passed a medical examination and have been properly trained in specific H&S hazards and in the use of respiratory protective equipment. All visitors must report to the field team leader.
- All personnel entering the site will be thoroughly briefed on hazards, equipment requirements, safety practices, emergency procedures, and communication methods.
- Protective clothing and respiratory protective equipment will be used for various stages of the operation as needed. The levels of protection are described in Section 7.2 of this H&S plan and will depend on the degree of hazard.

- Food, beverages, and tobacco products will not be allowed in contaminated areas or potentially contaminated areas. Taking medication, smoking, and applying cosmetics are also prohibited. These activities are allowed only in the established clean room and clean areas.

- Before eating, drinking, or smoking, employees will remove outer protective garments and wash their hands.

- Before leaving the site at the end of each work shift personnel who worked in contaminated zones will thoroughly shower or wash themselves to remove any contaminants.

- Containers will be moved only with the proper equipment and will be secured to prevent dropping or loss of control during transport.

- Emergency equipment will be located in readily accessible uncontaminated locations. A complete first-aid kit will be readily available on site. A fire extinguisher will be located not more than 25 ft from the work activity. An eyewash capable of washing both eyes at once and delivering at least 0.4 gals of water per minute for at least 15 min will be readily available. At least one eyewash will be maintained in the CRZ.

- Employee entrance and exit routes will be planned, and emergency escape routes will be designated. A map showing emergency escape routes will be posted at the site.

- Work areas will be illuminated to a minimum of 20 footcandles. Supplementary lighting may be necessary at night, inside buildings, in tanks, or in poorly lit areas.

- All operators of equipment used on site will be familiar with the requirements for inspection and operation of such equipment. Unfamiliar operations will be discussed with affected employees before work begins. The field team leader will be responsible for checking the proficiency of the operator. Perimeter barricades will be placed around the equipment used in a fixed location. Audio and/or visual back-up alarms will be used on all heavy equipment on site.

- Personnel will be transported only by means prescribed for movement of personnel. When trucks or other heavy equipment enter or leave the site, an individual shall direct the driver.

- No electrical equipment will be permitted in areas where a flammable atmosphere may exist. All static ignition sources will be identified and eliminated through use of bonding and grounding techniques.

MSDSs will be obtained for every chemical product used on site. This information will be stored in a central location and made readily available to all employees upon request. MSDSs, or applicable information, will be available with regard to materials used in soil collection and drilling activities. All containers of chemical products will

be properly labeled to comply with the OSHA Hazard Communication Standard 29 CFR Part 1910.1200 (OSHA 1991, 0610).

On-site personnel will use the buddy system. Buddies will maintain visual contact with one another. Personnel must observe each other for signs of heat stress or toxic exposure such as

- changes in complexion;
- changes in coordination or demeanor;
- excessive salivation and pupillary response; or
- changes in speech pattern.

Personnel will inform the supervisor of nonvisual effects of toxic exposure such as

- headaches, dizziness, or blurred vision;
- nausea or cramps; or
- irritation of eyes, skin, or respiratory tract.

Walking and working surfaces may become wet and slippery while employees are performing tasks, requiring extra caution. Visible barriers will be erected around any open excavations. Employees will keep the work and support areas neat and orderly and free of trash and debris.

A designated break area will be upwind from the excavation area and outside the CRZ. The area must be clearly marked and no contaminated personnel or equipment will be permitted to enter.

If the facility does not have a water supply available, potable water will be carried to the site for use in decontamination and employee cleanup activities. All refuse will be deposited in designated containers while on site. The field team leader and the site safety officer have the responsibility to ensure that the area is kept clean.

9.0 DECONTAMINATION PROCEDURES

This section outlines the procedures for developing an effective decontamination plan. Decontamination is the process of sequentially removing or neutralizing contaminants that have accumulated on equipment and personnel. The objectives of the decontamination process are to protect workers from exposure to the contaminants and to minimize the transfer of contaminants into clean areas.

The degree of expected contamination depends on the tasks to be conducted under the SAPs in this work plan. Contact with hazardous substances is possible; therefore, it is assumed that all personnel and equipment engaged in field activities are potentially contaminated and that decontamination is required. The types of

material to be addressed by decontamination procedures for OU 1148 include the following:

- contaminated soil in the form of dust or mud;
- contaminated sediment and sludge; and
- contaminated liquid or aerosol resulting from splashing or spraying.

General guidelines for decontamination are cited in Section 10.0 of the IWP, General Equipment Documentation, Annex III, H&S plan.

A decontamination plan will be developed and implemented before any personnel are permitted to enter areas where the potential for contamination exists. The elements of this plan must be documented on the daily activity logs. Personnel performing decontamination for the ER Program must certify that they have read and understood this procedure as well the procedures in the current version of the IWP.

9.1 Contamination Prevention

Minimizing contamination at the outset promotes effective decontamination. The following preventive measures are included in the ER Program for decontamination:

- avoid contact with hazardous substances as much as possible;
- use remote sampling, handling, and container-opening techniques;
- encase instruments and equipment with bags or coatings;
- bag or coat the exterior of sample containers; and
- use disposable garments and equipment where appropriate.

9.2 General Equipment Decontamination

The supplies necessary for equipment decontamination include solutions for decontamination, the appropriate cleaning supplies, and protective gear for personnel conducting decontamination. The level of protection required for decontamination personnel will be adjusted according to the degree of contamination that is expected or determined.

All equipment used during the field procedures will be subject to decontamination procedures, except for disposable items. The types of equipment to be employed during sampling include monitoring equipment, sampling tools, heavy equipment, and vehicles. In addition, contamination must be removed from the exterior of sample containers to prevent exposure to field team members and laboratory personnel. Plastic bags must be sealed with a rubber band at the neck of the container to minimize the potential for gross contamination on site. The contents of

the bags can be transferred to clean bags at the outer boundary of the exclusion zone and any residual contamination can be removed. The decontamination process must be designed to avoid contaminating the sample.

Reusable protective equipment must be decontaminated using a soap- and water-wash and two successive rinses. All heavy equipment and vehicles that are suspected of contamination must be steam-cleaned using high-pressure washers. All decontamination rinsate must be collected in approved containers.

9.3 Personnel Decontamination

Decontamination stations will be located in the contamination reduction zone (CRZ).

The supplies and equipment necessary for decontamination of personnel correspond to the level(s) of protection required for the activities on the site and call for solutions and cleaning supplies, a rest area, and a shower facility.

Personnel decontamination should be performed for all levels of protection. The degree of decontamination required will depend on the nature and magnitude of contamination.

9.4 Decontamination Support

If the sampling crews need assistance with decontamination, field team members will serve as support. Support team responsibilities include setting up the decontamination line, maintaining supplies, briefing the sampling crews in the decontamination line, and implementing emergency decontamination plans.

During the briefing sessions for the decontamination process, the support team will apprise the sampling crew of the proper steps and activities at each station. In cases in which a relatively involved decontamination line exists, the sampling crews will proceed through a dry run before the decontamination line goes into operation.

Emergency decontamination may be necessary for persons who must evacuate the site under emergency conditions or because of injury. These procedures are detailed in Section 10.0 of the H&S plan. It is imperative that the support team be prepared to perform these procedures.

The level of protection used by the support team will depend on the degree of contamination that is anticipated. In general, the support team will use Level C protection when field team members are dressed in Level B or C clothing. A decontamination support team will not be necessary where Level D protection is used.

9.5 Disposal Procedures

Disposable clothing and equipment will not need to be decontaminated, but will be considered hazardous waste. In addition, all decontamination solutions and rinse

water will be contained, collected, and disposed of as suspected hazardous waste. Arrangements will be made with the Laboratory for acquisition and disposal of drums containing soapy water, rinse water, methanol, and trash.

9.6 Decontamination Verification

The decontamination of any equipment or protective gear to be removed from a contaminated area to a controlled or uncontrolled area must be done with HS-1 approval and oversight. Protective clothing and equipment will be visually inspected for the effectiveness of decontamination. Screening procedures will be performed with a radiation detector in accordance with ER Program SOPs.

Procedures for the decontamination and transport of the decontamination blank are provided in ER Program SOP-01.04, "Sample Control and Field Documentation"; SOP-01.02, "Sample Containers and Preservation"; and SOP-01.03, "Handling, Packaging, and Shipping of Samples."

10.0 EMERGENCY-RESPONSE PROCEDURES

This section presents the emergency-response plan, describes contingency plans for specific types of emergencies, describes the actions required by the Laboratory in the event of a release of radioactive and/or toxic materials, and outlines pertinent requirements for notification and documentation of emergencies. Additional references for this section include Sections 6.0 and 13.2 of the H&S plan; Laboratory AR 1-1, "Accident/Incident Reporting"; AR 1-2, "Emergency Preparedness"; AR 1-8, "Working Alone"; and Laboratory TB 101, "Emergency Preparedness."

The site safety officer, with assistance from the field team leader, will have responsibility and authority for coordinating all emergency-response activities until the proper authorities arrive and assume control. A copy of the emergency-response plan will be available at the site at all times and all personnel working at the site will be familiar with the plan.

10.1 Emergency-Response Plan

This section describes the elements of the emergency-response plan for OU 1148. This plan will be adjusted for conditions specific to each SWMU.

10.1.1 Emergency Contacts

The names of persons and services to contact in case of emergency are provided in Attachment III-3. This emergency-contact form will be completed by the site safety officer prior to the start of field work and will be copied and posted in prominent locations at the site. Two-way radio communication will be maintained at remote sites when possible.

10.1.2 Site Mapping

A copy of the site map will be modified to indicate the following areas of importance in the emergency-response plan:

- hazardous areas (especially potential IDLH atmospheres);
- site terrain (topography, buildings, barriers);
- site accessibility by road and air (indicating current detours);
- work zones/work crew locations;
- surrounding population/environment;
- shelters and safe areas; and
- evacuation routes.

Current maps of evacuation routes and emergency facilities are shown in Figures III-5 and III-6.

10.1.3 Site Security and Control

In an emergency, the field team leader (or a designee) is responsible for controlling the entry of personnel into hazardous areas and accounting for all individuals on site. Depending on the nature and size of the SWMU, a checkpoint will be established in advance for control. The buddy system will remain in effect at all times for personnel working on site. If a security problem occurs, one short blast will be sounded from an air horn, and field team members will remain in place to await instructions from security.

10.1.4 Communications

Internal communication refers to communication between field team members. The objectives of internal communication are to alert workers to danger, convey safety information, and maintain site control. Routine communications for OU 1148 will depend on the area represented by the work zones and the tasks associated with that area. Where there is substantial distance between the workers providing support and the workers conducting sampling activities, two-way radio communication will be employed. A set of predetermined hand signals will be used if radio communication fails. This contingency is especially important for workers wearing Levels B and C protective equipment.

Emergency communication will also be established for the site. An air horn will be used to notify field team members of the following conditions:

- major fire -- two long blasts,

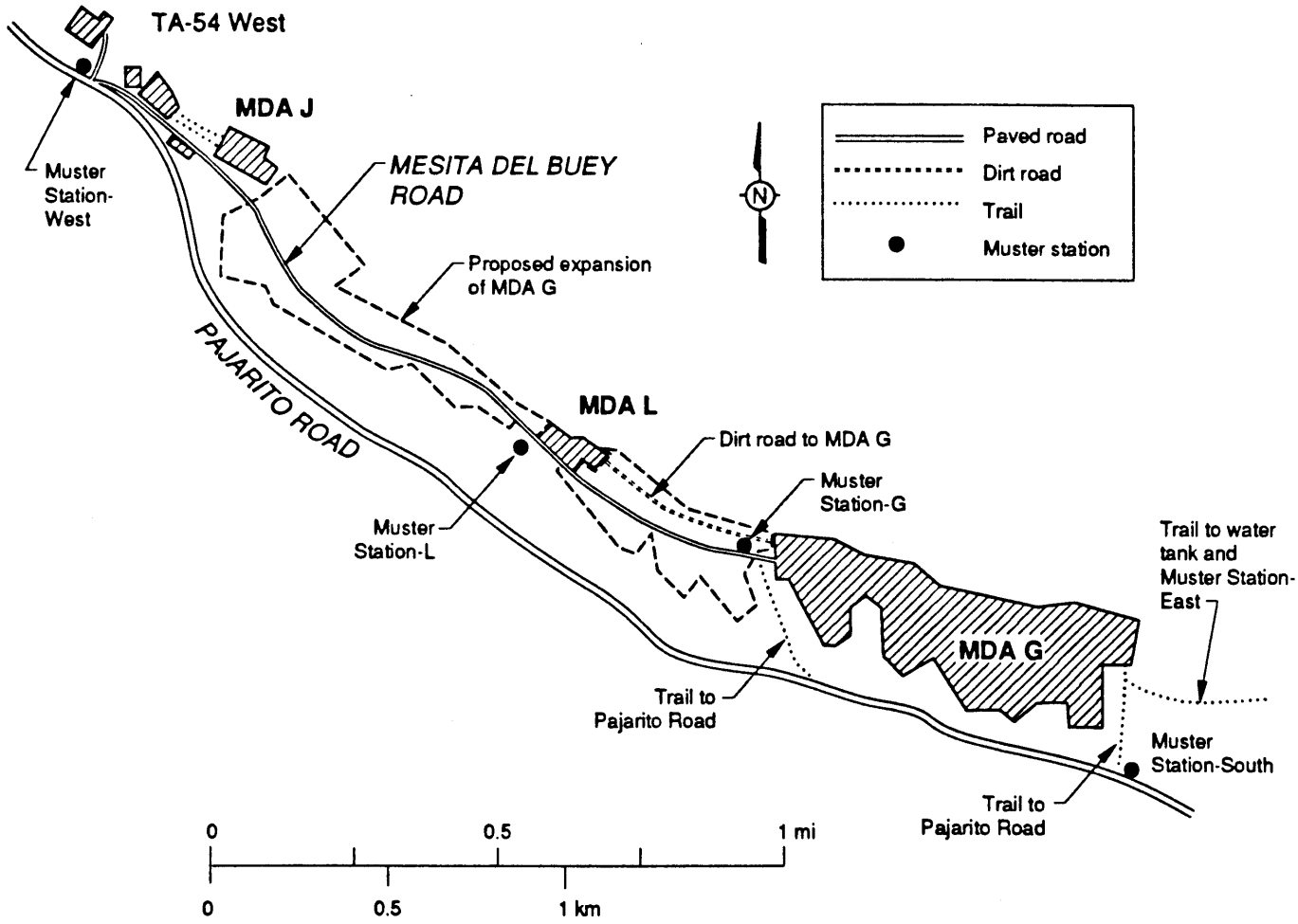


Figure III-5 Evacuation roads and trails and muster stations at OU 1148 (modified from Benchmark Environmental Corp, 1990).

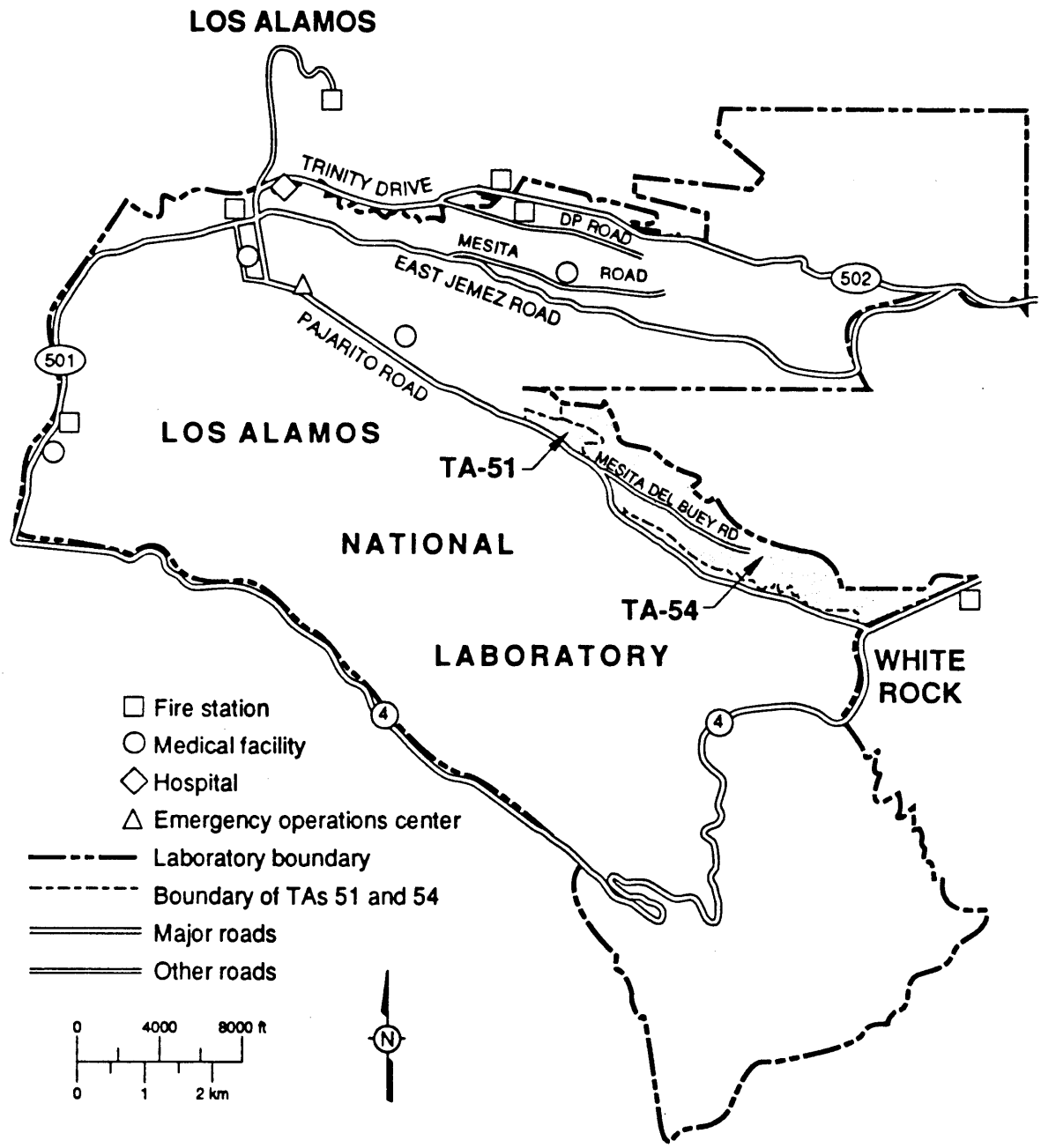


Figure III-6 Emergency facilities for field work at OU 1148.

- major release of hazardous substances -- two short blasts,
- minor fire or release -- one long blast,
- security problem -- one short blast.

A description of all signals will be posted in a prominent location at the site.

External communication will be necessary to request assistance or to notify the appropriate authorities about hazardous conditions that may impact public or environmental safety. The names and phone numbers of appropriate contacts will be posted in a prominent location. If a telephone is not available on site, the nearest public telephone will be located before sampling begins. All site personnel must be informed of this location.

Communication protocols will be explained at the daily tailgate safety meetings and reviewed at least once a week for the duration of sampling activities.

10.1.5 Evacuation Routes and Procedures

If a fire, explosion, or release of potentially hazardous materials occurs, field team members may need to retreat to a safe area or evacuate the site. Procedures for evacuation will depend on the nature and size of the SWMU under investigation. Field team members will assemble at a predesignated safe site if an evacuation is necessary.

If the area is relatively small and/or unconstrained, field team members will be able to exit the exclusion zone at the most convenient point, preferably in the upwind direction. Areas that are expected to be safe will be indicated on the site map.

At sites in which a relatively large exclusion zone exists or in areas that are constrained in some way (e.g., surrounded by a fence, located within a trench, bordered by steep cliffs), evacuation routes will be established in advance and illustrated on the site map.

In either case, all field team members will report to a designated checkpoint to be accounted for by the field team leader. All field team members will be informed of the evacuation procedures specific to each SWMU.

10.1.6 Emergency Equipment and Supplies

The site safety officer (or a designee) will be responsible for maintaining emergency equipment and for restocking supplies. The type and amount of emergency equipment will be selected on the basis of the potential hazards.

10.2 Specific Emergencies

10.2.1 Fire/Explosion

Fire extinguishers may be effective for small, contained fires. One long blast of an air horn will be used to signal a minor fire or release. Field team members will meet and be counted at a designated checkpoint. For a major fire or explosion, evacuation will be signaled by two long blasts. Field team members will report to a specified location (such as evacuation vehicles) and proceed away from the fire. One individual will locate the nearest phone at a safe distance and call the Los Alamos County Fire Department at 911. If an explosion occurs, all personnel will be evacuated and no one will re-enter the work area until it has been cleared by Laboratory explosives safety personnel.

10.2.2 Radiation/Chemical Exposures

A minor release of potentially hazardous materials will be indicated by one long blast of an air horn. All personnel will assemble at the designated checkpoint and be counted by the field team leader (or a designee). The site safety officer will issue further instructions.

Two short blasts of an air horn will alert field team members to a major release involving hazardous or radioactive materials. Field team members will meet at a checkpoint predetermined on the basis of wind direction. A portable wind sock or streamer will be positioned at each site. If the source of the release is directly upwind, field team members will move to the exit and away from the plume. Once the team achieves a safe distance, the field team leader and the site safety officer will account for all site personnel. The site safety officer will determine a further course of action.

Exposure to radiation and/or chemicals will be reported to the Laboratory's Occupational Medicine Group HS-2. The Los Alamos County Medical Center will be notified of life-threatening or serious exposures. If a field team member is exposed to hydrofluoric acid, a special paste must be obtained from HS-2 and applied to the patient's affected area(s), and the hospital must be notified immediately.

10.2.3 Injuries

Trained personnel may treat minor injuries on site. Seriously injured victims will be transported to a medical facility as soon as possible. The Los Alamos County Fire Department provides emergency transport services.

If an injured person has been contaminated with chemicals, decontamination will be performed only if it will not aggravate the injury. Emergency decontamination is discussed in Section 10.0 of the H&S plan.

10.2.4 Vehicle Accidents/Property Damage

In addition to the required police report, a vehicle accident report must be filed in accordance with DOE. These requirements are described in Section 10.4 of this H&S plan. Injuries incurred in an accident will be treated in the manner described in Section 10.2.3 of this H&S plan.

10.3 Provisions for Public Health and Safety

Emergency planning is presented in the Laboratory's ES&H manual (LANL 1990, 0335). The Laboratory identifies four situations in which hazardous materials may be released into the environment. These categories are founded, in part, on Emergency Response Planning Guideline (ERPG) concentrations developed by the American Industrial Hygiene Association (AIHA) and on the basis of the maximum concentration of toxic material that can be tolerated for up to 1 h.

Four types of emergencies are defined as follows:

- UNUSUAL EVENT: An event that has occurred or is in progress that normally would not be considered an emergency, but that could reduce the safety of the facility. No potential exists for significant releases of radioactive or toxic materials off site.

- SITE ALERT: An event that has occurred or is in progress that would substantially reduce the safety level of the facility. Off-site releases of toxic materials are not expected to exceed the concentrations defined in ERPG-1.

- SITE EMERGENCY: An event that has occurred or is in progress that involves actual or likely major failures of facility functions necessary for the protection of human health and the environment. Releases of toxic materials to areas off the site may exceed the concentrations described in ERPG-2.

- GENERAL EMERGENCY: An event that has occurred or is in progress that substantially interferes with the functioning of facility safety systems. Releases of radioactive materials to areas off the site may exceed protective response recommendations and toxic materials may exceed ERPG-3.

The ERPG concentrations as well as the appropriate emergency response actions, are summarized in Section 6.0 of the IWP, Annex III, H&S Plan (LANL 1990, 0144).

10.4 Notification Requirements

Field team members will notify the site safety officer of emergency situations. The site safety officer is responsible for notifying the appropriate emergency assistance personnel (e.g., fire, police, and ambulance), the OU PL, and the Laboratory HS

Division Office according to DOE Order 5500.2 (DOE 1991, 0736), DOE-Albuquerque Operations Office (AL) Order 5000.3 (DOE/AL 1991, 0734). The Laboratory HS Division Office is responsible for implementing notification and reporting requirements according to DOE Order 5484.1 (DOE 1990, 0773).

10.5 Documentation

An unusual occurrence is any deviation from the planned or expected behavior or course of events in connection with any DOE or DOE-controlled operation if the deviation has environmental protection, safety, or health protection significance. Examples of unusual occurrences would include any substantial degradation of a barrier designed to contain radioactive or toxic materials, or any substantial release of radioactive or toxic materials. Proper reporting procedures are detailed in Section 13.2 of the H&S plan.

The Laboratory principal investigator will submit a completed DOE Form F 5484.X for any of the following accidents and incidents, according to Laboratory AR 1-1:

- OCCUPATIONAL INJURY is any injury such as a cut, fracture, sprain, or amputation that results from a work accident or from an exposure involving a single incident in the work environment. Note: Conditions resulting from animal bites, such as insect or snake bites, or from one-time exposure to chemicals are considered injuries.

- OCCUPATIONAL ILLNESS of an employee is any abnormal condition or disorder, other than one resulting from an occupational injury, caused by exposure to environmental factors associated with employment. It includes acute and chronic illnesses or diseases that may be caused by inhalation, absorption, ingestion, or direct contact with a toxic material.

- PROPERTY DAMAGE LOSSES OF $1,000 OR MORE: Regardless of fault, accidents that cause damage to DOE property, or accidents wherein DOE may be liable for damage to a second party, are reportable where damage is $1,000 or more. The $1,000 includes damage to facilities, inventories, equipment, and properly parked motor vehicles, but excludes damage resulting from a DOE-reported vehicle accident.

- GOVERNMENT MOTOR-VEHICLE ACCIDENTS RESULTING IN DAMAGES OF $150 OR MORE OR INVOLVING AN INJURY, unless the government vehicle is not at fault or the occupants are uninjured. Accidents are also reportable to DOE if:

  - damage to a government vehicle not properly parked is greater than or equal to $250;

  - damage to DOE property is greater than or equal to $500 and the driver of a government
  - vehicle is at fault;

- damage to any private property or vehicle is greater than or equal to $250 and the driver of
- a government vehicle is at fault; or

- any person is injured and the driver of a government vehicle is at fault.

The H&SPL will work with the OUPL and the field team leader to ensure that H&S records are maintained with the appropriate Laboratory group, as required by DOE orders. The reports are as follows:

- DOE-AL Order 5000.3 (DOE 1990, 0253), Unusual Occurrence Reporting;

- DOE Form 5484.3, Supplementary Record of Occupational Injuries and Illnesses, DOE Order 5484.1 (DOE 1990, 0733);

- DOE Form 5484.4, Tabulation of Property Damage Experience, Attachment 2, DOE Order 5484.1 (DOE 1990, 0733);

- DOE Form 5484.5, Report of Property Damage or Loss, Attachment 4, DOE Order 5484.1 (DOE 1990, 0733);

- DOE Form 5484.6, Annual Summary of Exposures Resulting in Internal Body Depositions of Radioactive Materials, DOE Order 5484.1 (DOE 1990, 0733);

- DOE Form 5484.8, Termination Occupational Exposure Report, Attachment 10, DOE Order 5484.1 (DOE 1990, 0733);

- DOE Form OSHA-200, Log of Occupational Injuries and Illnesses, Attachment 7, DOE Order 5484.1 (DOE 1990, 0733);

- DOE Form EV-102A, Summary of Department of Energy and Department of Energy Contractor Occupational Injuries and Illnesses, Attachment 8 DOE Order 5484.1 (DOE 1990, 0773); and

- DOE Form F5821.1, Radioactive effluent/onsite discharges/unplanned releases; Attachment 12, DOE Order 5484.1 (DOE 1990, 0773).

Copies of these reports will be stored with the appropriate Laboratory group. Specific reporting responsibilities are given in the following sections and in Chapter 1, General Administrative Requirements, of the Laboratory ES&H Manual (LANL 1990, 0335).

REFERENCES

ACGIH (American Conference of Governmental Industrial Hygienists) 1990. 1990-1991 Threshold Limit Values for chemical Substances and Physical Agents and Biological Exposure Indices, ACGIH, Cincinnati, Ohio. (ACGIH 1990, 0726)

DOE/AL (US Department of Energy, Albuquerque Operations Office), December 13, 1982. "Environmental Protection, Safety, and Health Protection Program for AL Operations," DOE/AL Order 5480.1A, Change 1, Albuquerque, New Mexico. **DOE/AL 1982, 0729)**

DOE/AL (Us Department of Energy, Albuquerque Operations Office), September 24, 1984. "AL Emergency Planning, Preparedness and Response for Operations," DOE/AL Order 550.2A, Change 1, Albuquerque, New Mexico. **DOE/AL 1984, 0735)**

DOE/AL (US Department of Energy, Albuquerque Operations Office), October 24, 1986. "Unusual Occurrence Reporting System," DOE/AL Order 5000.3, Albuquerque, New Mexico. **(DOE/AL 1986, 0734)**

DOE (US Department of Energy), November 16, 1987. "Contractor Occupational Medical Program," DOE Order 5480.8, Washington, DC **(DOE 1987, 0731)**

DOE (Us Department of Energy), December 21, 1988. "Radiation Protection for Occupational Workers," DOE Order 5480.11, Washington, DC **(DOE 1988, 0076)**

DOE (US Department of Energy), March 27, 1990. "Environment, Safety, and Health Program for Department of Energy Operations," DOE Order 5480.1B, Change 4, Washington, DC. **(DOE 1990, 0730)**

DOE (US Department of Energy), June 29, 1990. "Radiation Protection for Occupational Workers," DOE Order 54801.11, Change 2, Washington, DC. **(DOE 1990, 0732)**

DOE (US Department of Energy), July 2, 1990. "Reactor and Nonreactor Nuclear Facility Emergency Planning, Preparedness and Response Program for Department of Energy Operations," DOE Order 5500.3, Change 1, Washington, DC. **(DOE 1991, 0737)**

DOE (US Department of Energy), October 17, 1990. "Environmental Protection, Safety, and Health Protection Information Reporting Requirements," DOE Order 5484.1, Change 7, Washington, DC. **(DOE 1990, 0733)**

DOE (Us Department of Energy), April 30, 1991. "Emergency Categories, Classes, and Notifications and Reporting Requirements," DOE Order 5500.2B, Washington, DC. **(DOE 1991, 0736)**

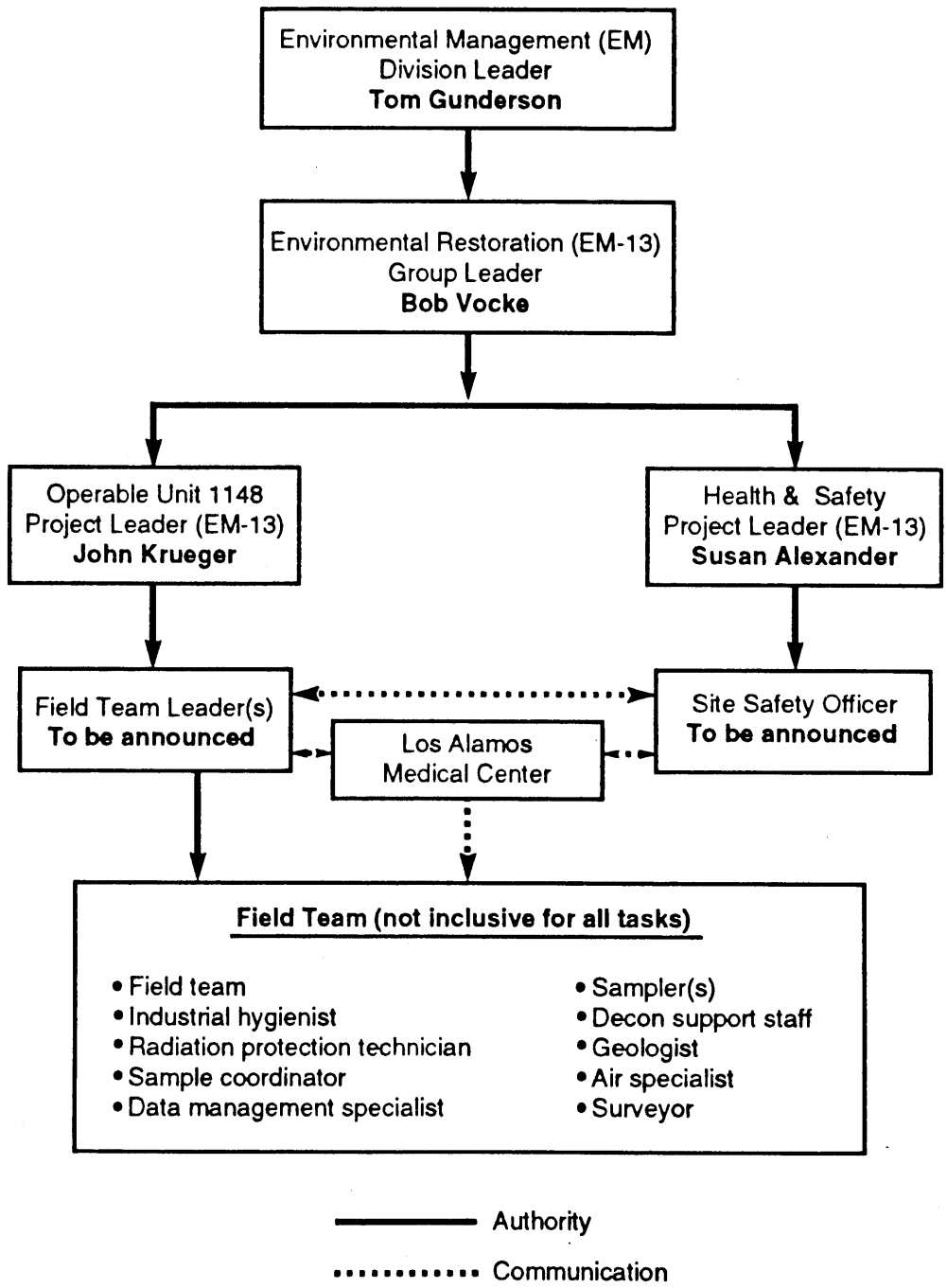
EPA (US Environmental Protection Agency), 1988, "Standard Operating Safety Guides," S0S6, Office of Emergency and Remedial Response, Hazardous Re-

sponse Support Division, Environmental Response Team, Washington, DC. **(EPA 1988, 0609)**

LANL (Los Alamos National Laboratory), June 1, 1990. "Environment, Safety and Health Manual," AR10-3, Chemical, Hazardous and Mixed Waste, Los Alamos, New Mexico. **(LANL 1990, 0335)**

LANL (Los Alamos National Laboratory), November 1990. "Installation Work Plan for Environmental Restoration," Los Alamos National Laboratory Report LA-UR-90-3825, Los Alamos, New Mexico. **(LANL 1990, 0144)**

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)**



Attachment III-1 OU1148 field work organization chart showing health and safety and quality assurance responsibility.

ATTACHMENT III-2

HEALTH AND SAFETY CHECK LIST

H&S PLAN

OPERABLE UNIT 1148

Date:_____Time:_____FIELD TEAM LEADER Signature_____

SITE SAFETY OFFICER Signature:_____

Activities being conducted, equipment being used, general condition and effectiveness of decontamination, PPE being worn:

_____

_____

_____

_____

_____

_____

_____

A key indicator of a well-maintained and safely operated site is the appearance of the work area on a daily basis. Work area appearance and safety are the responsibility of all personnel. Work areas shall be straightened on a daily basis before work stops. Time should be set aside at the end of each work period to remove trash, tools, spare parts, extra materials, rags, plastic, and so forth. Work in progress should be stopped and a general cleanup should be conducted whenever trash, dirt, or other materials are being spread beyond the immediate work area. The Site Safety Officer will complete this check list during his/her daily health and safety inspection tour of the work area.

This check list is designed so that any "no" responses are indicators of a safety or health deficiency. If any question does not apply, an "NA" will be placed on the line. Not all questions will be applicable to all sites. All "no" responses should be followed up with a written explanation, the corrective action taken, and the date.

ATTACHMENT 3

HEALTH AND SAFETY CHECK LIST Page 1 of 6		
TRAINING	**YES**	**NO**
Is a daily Tailgate Safety Meeting held and documented?		
Are all visitors to the site properly signed in and given site-specific orientation and safety training?		
Are all persons entering the site informed of the contents of the H&S Plan and required to sign a statement indicating such?		
Have all persons entering the site received the appropriate hazardous waste training, and is this training documented?		
Have all persons entering the site received a respirator fit test and training?		
Have all persons entering the site received training (hazard communication) on all hazards that may be encountered?		
Have all persons entering the site received the required physical examination?		
Is the H&S Plan available for on-site inspection and review by employees, etc.?		
Are emergency reporting and evacuation procedures known by each person on site and documented on the Emergency Contact sheet?		
Are all persons who enter confined spaces properly trained?		
Is the site-specific organizational structure chart posted at the job site?		
Are personnel who work on or near drill rigs instructed in the location and use of the rig's "kill" switch?		
Do heavy equipment and crane operators possess appropriate and up-to-date required licenses/certifications/permits?		
Are copies of all training records kept on site?		
INSPECTIONS	**YES**	**NO**
Are regulated areas established and defined for each work area in which contaminated materials may be present?		
Is hearing protection worn in areas where sound levels are suspected or shown to exceed 85 dBA?		

HEALTH AND SAFETY CHECK LIST

INSPECTIONS (Continued)	YES	NO
Are all persons on site using the minimum protective equipment (hard hat, safety glasses with side shields or goggles, steel-toed safety shoes) and appropriate clothing for the anticipated hazards?		
Is there a multipurpose dry-chemical fire extinguisher on each piece of heavy equipment?		
Are all fire extinguishers inspected monthly?		
Is the "no smoking" policy enforced?		
Are approved safety containers used to store fuels?		
Do all contaminated scrap, waste, debris, and clothing containers have labels?		
Is the food and beverage consumption prohibition enforced in the regulated area?		
Is there a method available for employees to wash their faces and hands with soap and water before eating and drinking?		
Are contaminated materials stored in tightly closed containers in well-ventilated areas?		
Does all heavy equipment have a functioning back-up alarm?		
Is the buddy system in use throughout the site?		
Is access to the regulated areas controlled so that only authorized personnel are permitted to enter?		
Is a daily log maintained of persons entering the regulated area?		
If benzene is present, are warning signs and benzene hazard signs posted?		
Are MSDSs for the hazardous materials posted at the site?		
Are contact lenses not worn with respiratory protection?		
Are all persons required to wear respirators clean-shaven before each day's shift?		

HEALTH AND SAFETY CHECK LIST

INSPECTIONS (Continued)	YES	NO
Are adequate potable liquids provided at the job site?		
Is periodic air monitoring conducted?		
Are air-monitoring instruments calibrated daily before use?		
Are emergency services and equipment available at the site and is equipment in appropriate condition?		
Are provisions made for adequate flushing of the skin or eyes in the event of contaminated exposure?		
Are dry-chemical ABC fire extinguishers provided at each site?		
Do all work activities begin after sunrise and end before sunset?		
Are potable water containers clearly marked as to their contents and not used for any other purpose?		
Are outlets for nonpotable water clearly marked?		
If permanent toilet facilities are unavailable, are chemical toilets provided?		
Do employees shower at the end of their work shift and when leaving a hazardous waste site?		
Are appropriate warning signs placed around open excavations?		
Are excavations sloped (1 ft to 1 ft), or shored if more than 4 ft deep?		
Is a standby person available when entry into an excavation is required?		
Are appropriate access methods, such as ladders, used to enter the excavation?		
Are equipment and materials stored and handled so as not to endanger personnel?		
Is a check-in/check-out roster maintained at the site?		
Are crane operators controlling the lift area maintaining a safe perimeter to prevent any site personnel from coming under or within an unsafe distance of a live load?		

HEALTH AND SAFETY CHECK LIST
Page 4 of 6

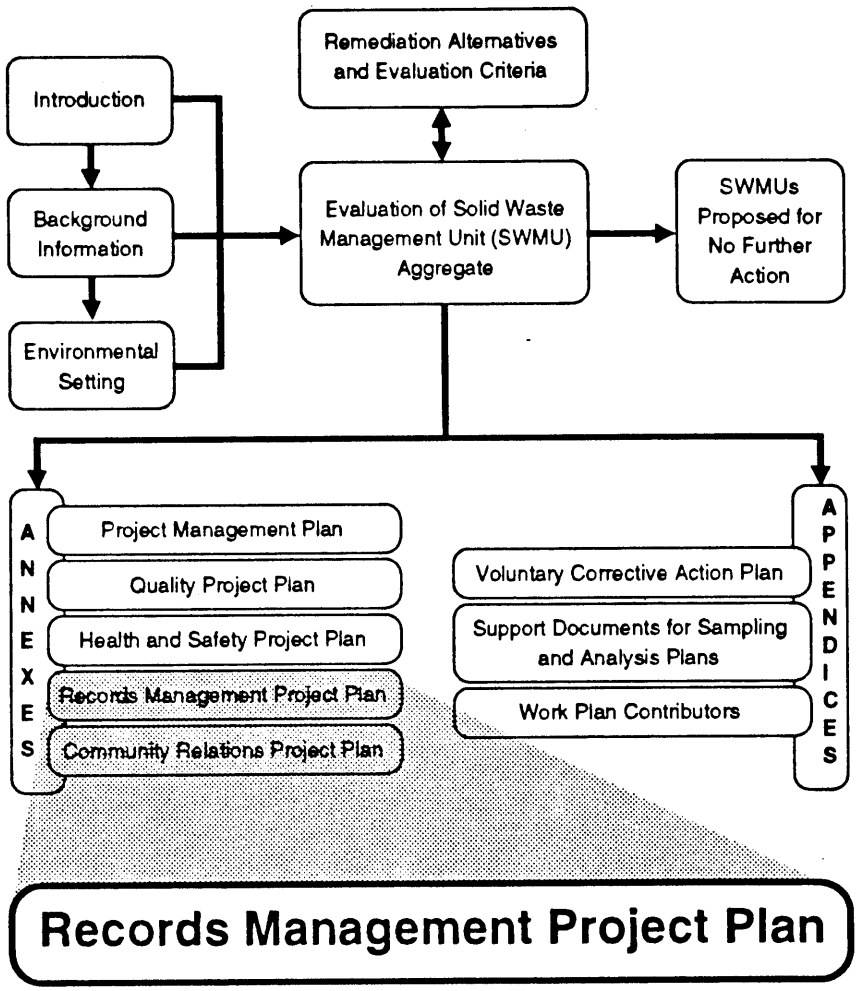
INSPECTIONS (Continued)	YES	NO
If personnel are required to work in or near high-traffic areas, are they wearing fluorescent orange and/or reflective clothing or vests?		
Are vehicles not actively used in operations parked so that they do not interfere with work or traffic?		
Are cutting and welding operations not allowed within 300 ft of a potential liquid fuel source or a building?		
Are supplied air respirators required for employees performing hot work on painted, galvanized, coated, or previously contaminated metal?		
Are two 10-lb or more ABC multipurpose fire extinguishers available in the immediate vicinity of hot work?		
Are seat belts used by persons riding in/on vehicles and equipment?		
Are personnel riding in/on vehicles or equipment in a manner designated for the conveyance of people?		
Is noncrane heavy equipment used to pull (lift) material properly equipped and designed to do so?		
Is a drilling-equipment safety-inspection report completed by the drilling operator before beginning any site work?		
Is all equipment used to handle or transfer flammable liquids bonded and grounded, spark proof, and explosion proof, as appropriate?		
Are all fuels stored in approved safety containers?		
Are fuel storage locations marked with the warning signs, "Flammable Liquids" and "No Smoking"?		
Are spark-proof hand tools used when working with flammable/combustible materials or when breaking lines?		
Are safety glasses and gloves worn when handling or hooking up compressed-gas cylinders?		
Are compressor hose segments secured using chains and/or locking pins?		
Are all electric connections made through a GFCI?		

HEALTH AND SAFETY CHECK LIST
Page 5 of 6

INSPECTIONS (Continued)	YES	NO
Are extension cords routed and stored to prevent damage and tripping hazards?		
Does a second person secure or steady a ladder while an employee is ascending and descending?		
Is stockpiled soil piled at an angle less than 45 degrees and at least 2 ft from the edge of an excavation?		
Is the regulated area isolated from the rest of the work site in a manner that minimizes the number of employees exposed to site containers?		
If heat stress is a concern, has a work/rest regimen been established and implemented, including physiological monitoring?		
If contaminants at the site are unknown, is Level B protection worn?		
Are suitable quantities of absorbent, appropriate drums and labels complying with DOT, OSHA, and EPA regulations on hand where leaks, spills, or ruptures may occur?		
Have procedures for all phases of decontamination been developed and implemented?		
Is the direction of emergency egress away from high-hazard areas?		
Are means of emergency egress maintained free of obstructions and available for full and instant use?		
Are work areas kept clean and in good repair with no unnecessary holes or openings?		
Are wastes (noncontaminated) kept in a closed, nonleaking sanitary container and removed as often as necessary and appropriate in a manner that would avoid creating a health or safety problem?		
Are appropriate labels provided on all chemical containers?		
Are storage areas free of accumulation of materials that could constitute a hazard from tripping, fire, explosion, or pest harborage?		
Is vegetation within the site controlled?		

HEALTH AND SAFETY CHECK LIST Page 6 of 6		
INSPECTIONS (Continued)	**YES**	**NO**
Is electrical equipment free of recognizable hazards that could cause injury?		
Are all machines maintained to prevent someone from being in the danger zone during the operating cycle?		
Are electrical equipment, cords, plugs, and cord sets inspected each day for external defects, deformed, broken, or missing pins, insulation damage, and indications of internal damage?		
Are extension cords protected from damage?		
Are flexible cords used only in continuous lengths without splices or tape?		
If compressed air is used, is it reduced to 30 lbs/in^2 or less with a chip guard?		

ANNEX IV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ANNEX IV: RECORDS MANAGEMENT PLAN

1.0 INTRODUCTION

The Records Management Plan (program plan) 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 program plan 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.

The ER Program uses the following statutory definition of a record [44 USC 3301 (ref.)]:

> 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 program plan establishes general guidelines for managing records, regardless of their physical form or characteristics, that are generated and/or used by the ER Program. The program plan 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 program plan 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 program plan describes the implementation of the records management program. Records management activities at Operable Unit (OU) 1148 will follow the guidelines summarized in that chapter. As the program plan develops to support OU needs, additional detail will be provided in annual updates of the IWP.

The program plan 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 program and project plans, management guidance documents, or records identified by ER Program participants as being essential to the program. 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 (Review and Approval of Environmental Program Plans and Reports), LANL-ER-AP-01.4 (Distribution of Controlled Documents Prepared for the Environmental Restoration Program), and LANL-ER-AP-01.5 (Revision of Intermin Charge of Environmental Restoration Program Controlled Documents), are also followed.

Records (including data) will be protected in and accessed through the referable information base. The referable information base includes all information systems maintained at 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 RPF and FIMAD will be used for managing records resulting from work conducted at OU 1148. Interaction with these facilities is described in LANL-ER-2.01, the program 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 program plan 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

The Laboratory's Occupational Medicine Group (HS-2) will maintain medical records because of their confidential nature. Training records will be maintained by appropriate custodians in coordination with Laboratory/DOE policy and will take into account the specific needs of the ER Program. FIMAD will only contain information about the completion of training, the dates of required refresher training, and the specific location of training records for program participants.

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 work at OUs contribute to the development of these deliverables.

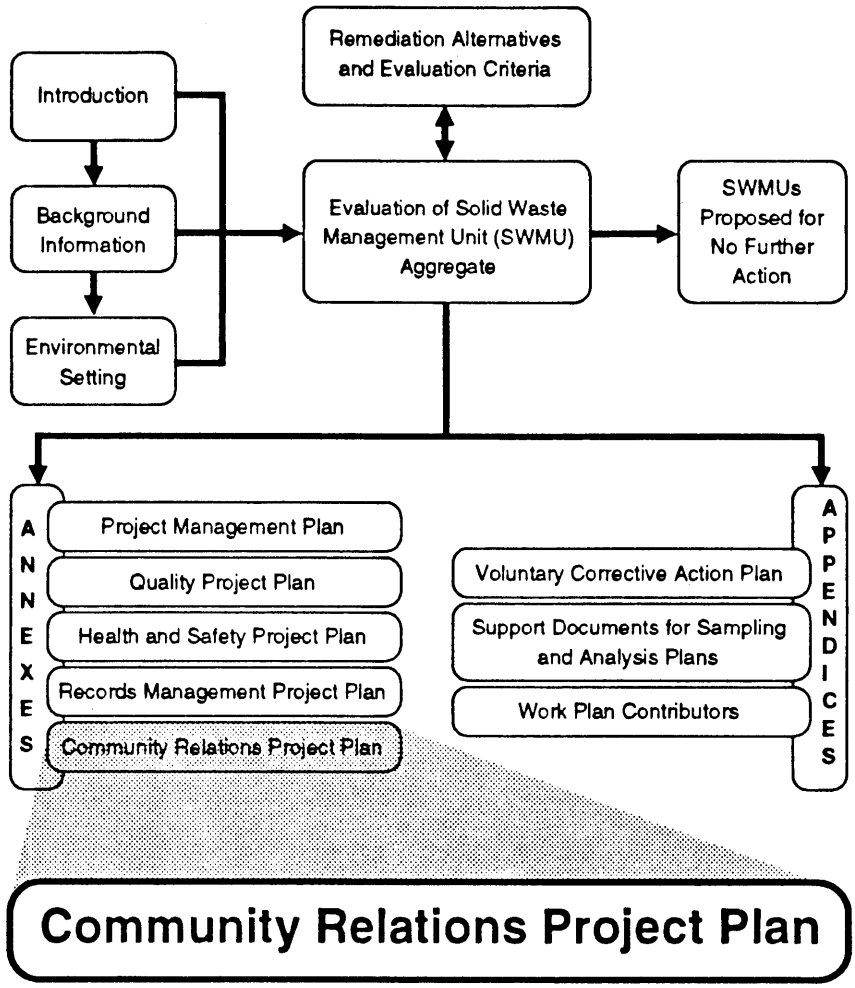
7.0 COORDINATION WITH THE COMMUNITY RELATIONS PROGRAM

RCRA requires that records be made available to the public; CERCLA requires that administrative records be made available to the public. Two complementary methods of providing information to the public, hard copy and electronic access, are being implemented. The community 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.

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 V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1.0 OVERVIEW OF COMMUNITY RELATIONS PROJECT PLAN

The Community Relations Project Plan (CRPjP) specific to Operable Unit (OU) 1148 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) for Environmental Restoration (ER) (LANL 1991, 0553). This annex describes the community relations activities for OU 1148 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 five-year RFI process as described in this project plan 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;
- providing to the public news releases, fact sheets, approved RFI work plans, RFI final reports, special permit conditions reports, phase reports, and available quarterly progress reports that explain the progress and conclusions of the RFI;
- creating a repository for public information and a reading room at which up-to-date information is provided;
- conducting informal meetings for the public and local officials, including briefings and workshops, as appropriate;
- conducting public tours and briefings to address individual concerns and questions;
- quarterly technical progress reports during the RFI process for the Administrative Authority; and
- establishing procedures for immediate notification of the San Ildefonso Pueblo or other affected neighboring parties in the event of a newly-discovered off-site release.

These items are addressed in Sections 2.1 through 2.6 of this plan.

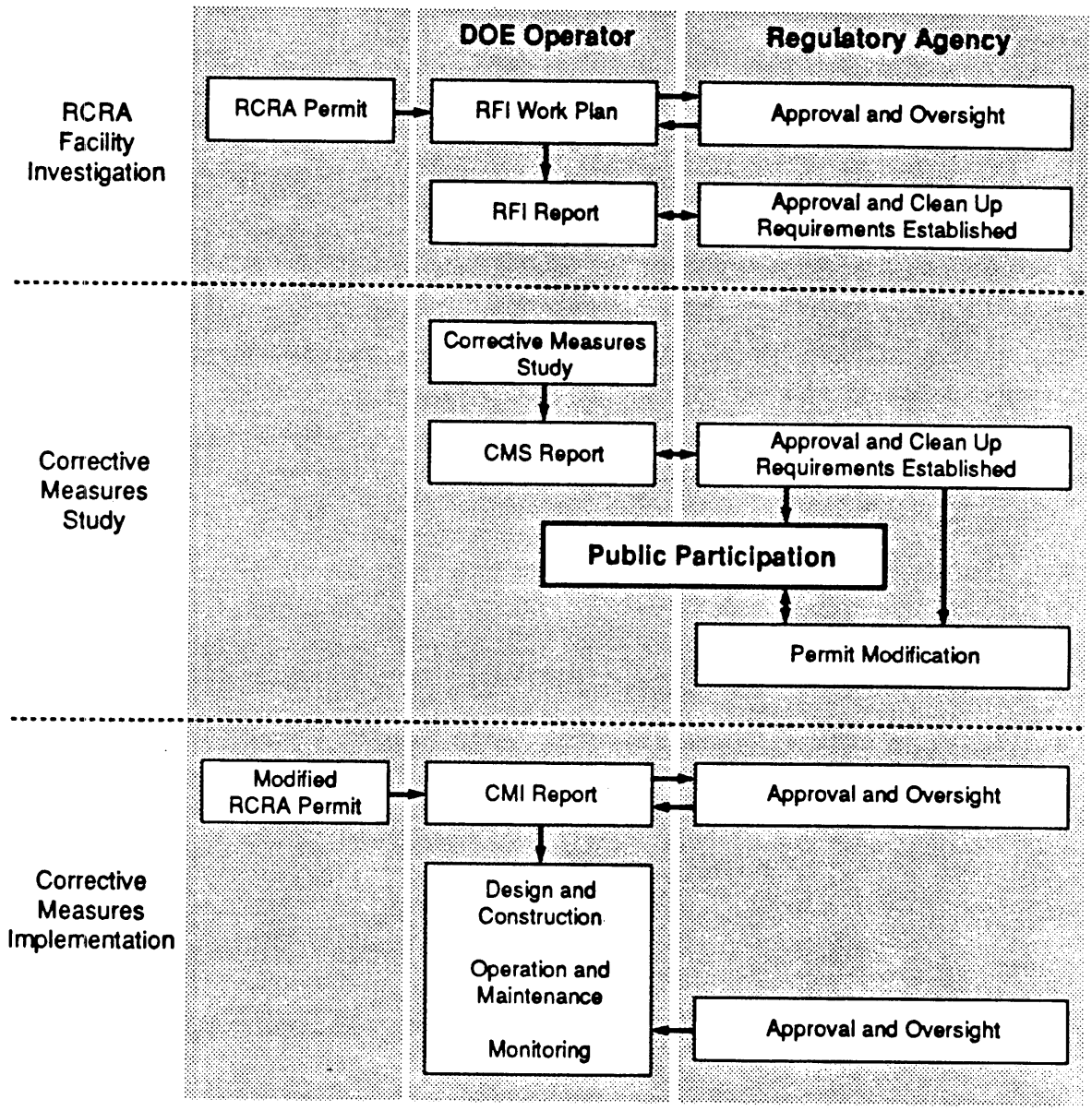


Figure V-1 Opportunities mandated by regulations for public participation during the RCRA corrective action process.

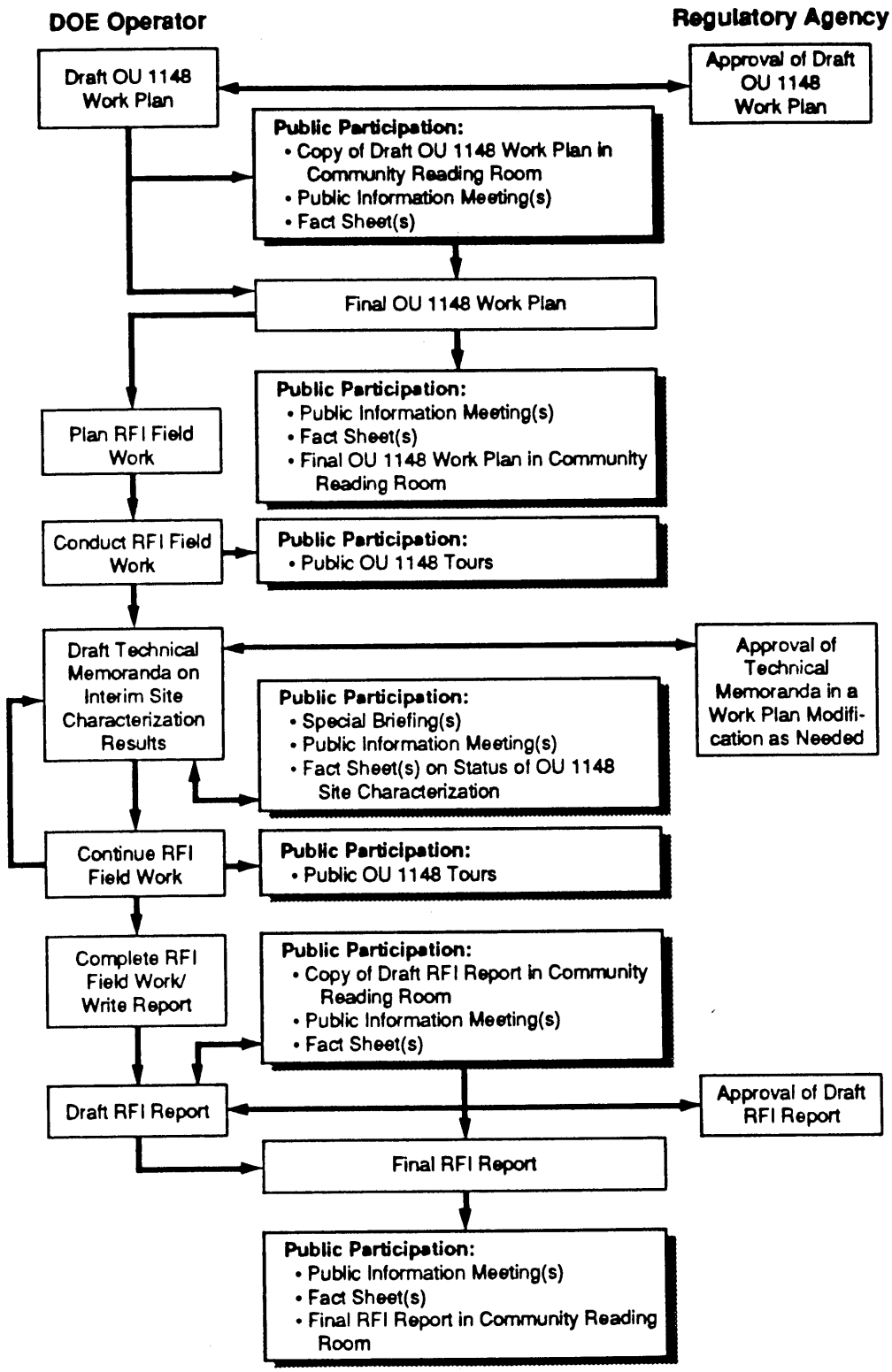


Figure V-2 Opportunities for public participation during the OU 1148 RFI.

All information concerning ER program activities at OU 1148 will originate with or be provided to the public through the community relations project leader as follows:

Christina Armijo (temporary)
Community Relations Project Leader
Environmental Restoration Program
Los Alamos National Laboratory
2101 Trinity Drive, Suite 20
Los Alamos, New Mexico 87545
(505) 665-2127

2.0 COMMUNITY RELATIONS ACTIVITIES

The following subsections provide a brief description of community relations activities to be conducted at OU 1148 during the RFI activities. The scope of each activity can be tailored to respond to public information needs.

2.1 Mailing List

The Community Relations office will add to the ER program mailing list any residents and businesses identified as owning property on or adjacent to Technical Area (TA)-51 and TA-54, as well as current and former workers at OU 1148, to keep them informed of meetings, activities, and schedules pertaining to the OU.

2.2 Fact Sheets

The Community Relations Office has developed a fact sheet with a map inset that illustrates OU 1148 and summarizes site history and use, known contaminants of concern, and planned activities (Attachment 1). These fact sheets will be updated to reflect changes in public needs and progress made during the remediation process. A map showing SWMU locations in OU 1148 will be available for public review in the ER Program's Public Reading Room.

2.3 ER Program Reading Room

As they are developed, documents and data associated with OU 1148, such as the RFI work plan, quarterly technical progress reports, and the RFI report will be made available to the public at the ER Program Reading Room at 2101 Trinity Drive, Suite 20, in downtown Los Alamos, from 9 am to 4 pm on Laboratory business days. A copy of the OU 1148 RFI draft work plan will be available at the reading room in June 1992.

2.4 Public Information Meetings, Briefings, Tours and Responses to Inquiries

Public information meetings have been held in Los Alamos to introduce the community to the ER Program. Quarterly public information meetings will be held to discuss specific OU 1148 activities and significant milestones within the RFI process. Tours will be conducted for interested parties upon request.

If an issue of concern with limited interest is raised at a public information meeting, a special briefing or a one-to-one meeting may be necessary. The community relations project leader and the OU project leader will coordinate responses to such inquiries.

2.5 Quarterly Technical Progress Reports

As the RFI for OU 1148 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 Program Reading Room.

2.6 Procedures for Public Notification

The ER Program is developing an administrative procedure to notify property owners and residents of any releases that might move off the Laboratory site.

2.7 Informal Public Review and Comment on the Draft OU 1148 RFI Work Plan for OU 1148

The Laboratory will encourage public input regarding field sampling proposed in the draft RFI work plan for OU 1148 following its submittal to Environmental Protection Agency (EPA) in May 1992. Public comment regarding numbers of samples, types of samples, and quality assurance samples (e.g., duplicate samples) will be incorporated, as appropriate, into the final RFI work plan for OU 1148.

REFERENCES

EPA (U.S. Environmental Protection Agency), April 10, 1990. Module VII 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)

ATTACHMENT 1

OU 1148 Fact Sheet

ATTACHMENT 1

LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL RESTORATION PROGRAM

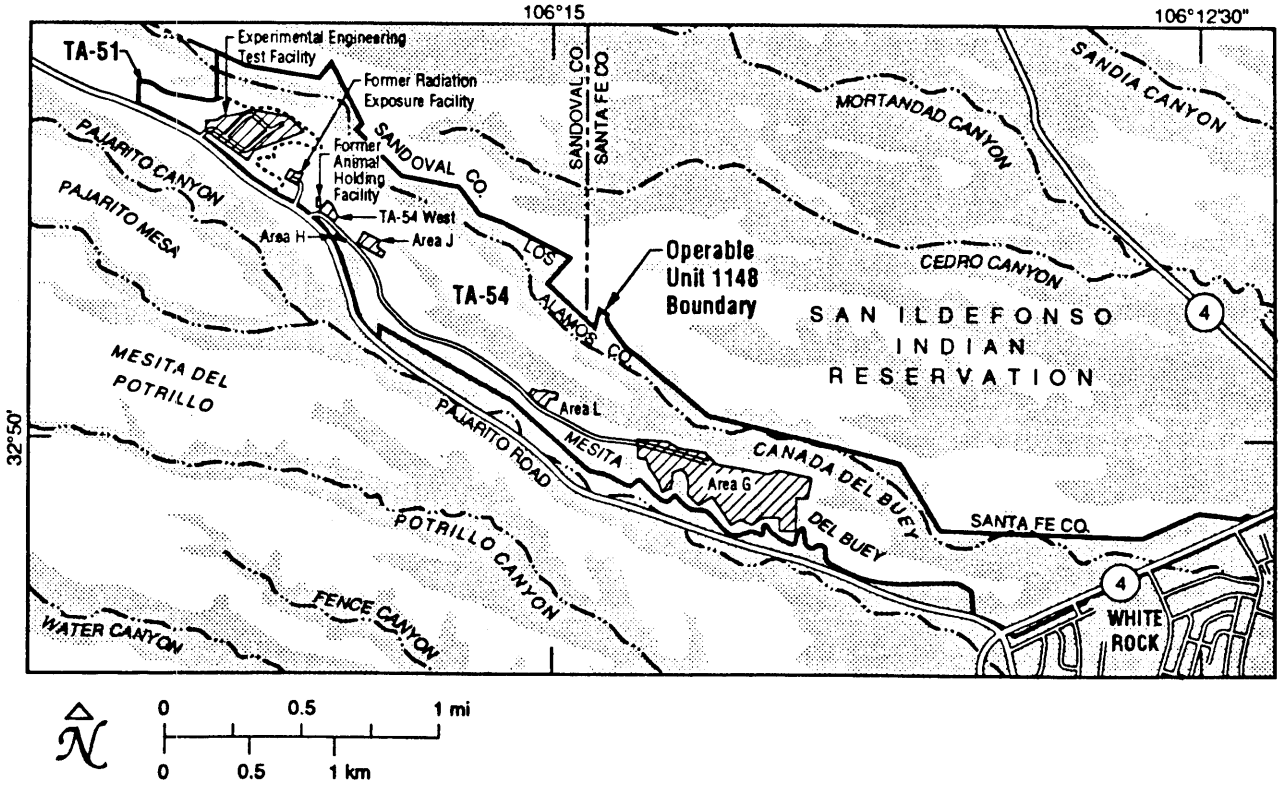
FACT SHEET FOR OPERABLE UNIT 1148 (TECHNICAL AREAS 51 and 54)

- An Operable Unit is a logical grouping of potential contaminated release sites called Solid Waste Management Units (SWMUs). Operable Unit 1148 consists of SWMUs in Technical Areas (TAs) 51 and 54. The two TAs are located on an east-west trending mesa (Mesita del Buey) bounded by Cañada del Buey to the north and Pajarito Canyon to the south. The TAs are on DOE controlled property.

- TA-51 is currently the base of operations for the Experimental Engineering Test Facility which supports research on effective isolation techniques for the burial of wastes in dry climates. The research began in 1980, and support offices for staff were constructed in 1986.

- TA-54 contains four waste handling/disposal areas enclosed by security fences (G, H, J, and L) and three other facilities located in the western part of the TA. Area G is the low-level radioactive waste landfill for the Laboratory. Solid low-level radioactive waste disposal was initiated in 1957. Area G is also used for storage of radioactive and hazardous mixed waste. Area H is an inactive disposal facility used for disposal of classified waste. Waste disposal occurred from 1960 to 1986. Area J is an active facility for the disposal of nonhazardous waste. Area L is a permitted facility for treatment and storage of hazardous waste. Disposal of chemical wastes occurred in pits, impoundments, and shafts at Area L from the late 1950s to 1985. There have been no chemical waste disposed of at Area L since 1985.

Operable Unit 1148 Locator Map



- TA-54 West performs final verification testing and certification of plutonium-containing waste that will be transported to the Waste Isolation Pilot Project site. Construction of the facility was completed in 1990. A former animal holding facility located in the western part of TA-54 housed animals used in biomedical research over a 20 year period from the 1960s to the 1980s. The facility is currently being remodeled as a laboratory to analyze environmental samples. A former radiation exposure facility was in operation in the western part of TA-54 from 1962 to the mid 1970s for research on animals. The radiation sources were removed when the research was terminated. Currently, the facility is used for research on the exposure of animals to oxides of nitrogen.

- For many years, the Laboratory has conducted a comprehensive environmental monitoring and surveillance program in Los Alamos County and throughout Northern New Mexico. The program is designed to identify releases from Laboratory operations which could pose a health risk to individuals living in the communities surrounding the Laboratory. No contamination is known to exist on private property which threatens the health and safety of local residents. This finding is based on assessment of technical data gathered from this program. If an imminent health threat is found, immediate action will be taken by the Department of Energy (DOE) and the Laboratory.

BACKGROUND OF OPERABLE UNIT 1148

TA-51. The three SWMUs in TA-51 include two multiple-celled water-tight structures (caissons) that are used for research studies on the design of covers to protect and isolate waste burial sites and an active septic system. The research caissons have never managed hazardous waste. The septic system is not expected to be contaminated with hazardous substances. However, the septic system will be investigated for contamination after the Laboratory does a sanitary system upgrade.

TA-54. The 45 SWMUs in TA-54 are organized within the four waste handling/disposal areas, and the three facilities located in the western part of the TA.

- The 24 SWMUs in Area G include low-level solid radioactive waste disposal pits and shafts, radioactive waste storage pits and shafts, surface storage of solid radioactive waste, septic systems, sumps, an underground tank, a waste compactor, and a truck washing pit. A vapor plume of tritium and volatile organic contaminants is present in the unsaturated rocks immediately below Area G. An active monitoring program has determined that the plume does not pose a threat for contamination of groundwater at the present time.

- The SWMU in Area H is a set of nine inactive disposal shafts. Environmental monitoring and disposal records have shown that tritium was disposed in Area H.

- The SWMU in Area J includes three pits and two shafts for disposal of nonhazardous waste. There are no known environmental releases from the area.

- The 13 SWMUs in Area L include inactive chemical waste disposal pits, shafts, and impoundments, storage areas for mixed waste, surface treatment and storage areas for hazardous waste, a PCB storage building, a compressed gas cylinder storage area, a drum compactor, and a sanitary waste holding tank. A vapor plume of volatile organic contaminants is present in the unsaturated rocks immediately below Area L. An active monitoring program has determined that the plume does not pose a threat for contamination of groundwater at the present time.

- The four SWMUs in TA-54 West include a waste staging area, a sump, a truck washing pit and a septic system. TA-54 West is newly constructed and has not been placed in operation so there have been no environmental releases. The septic system is not expected to be contaminated with hazardous or radioactive waste. However, it will be investigated for contamination after the Laboratory does a sanitary system upgrade.

- The two SWMUs in the former radiation exposure facility and the former animal holding facility are the active septic systems. The systems are not expected to be contaminated with hazardous or radioactive waste. However, they will be investigated for contamination after the Laboratory does a sanitary system upgrade.

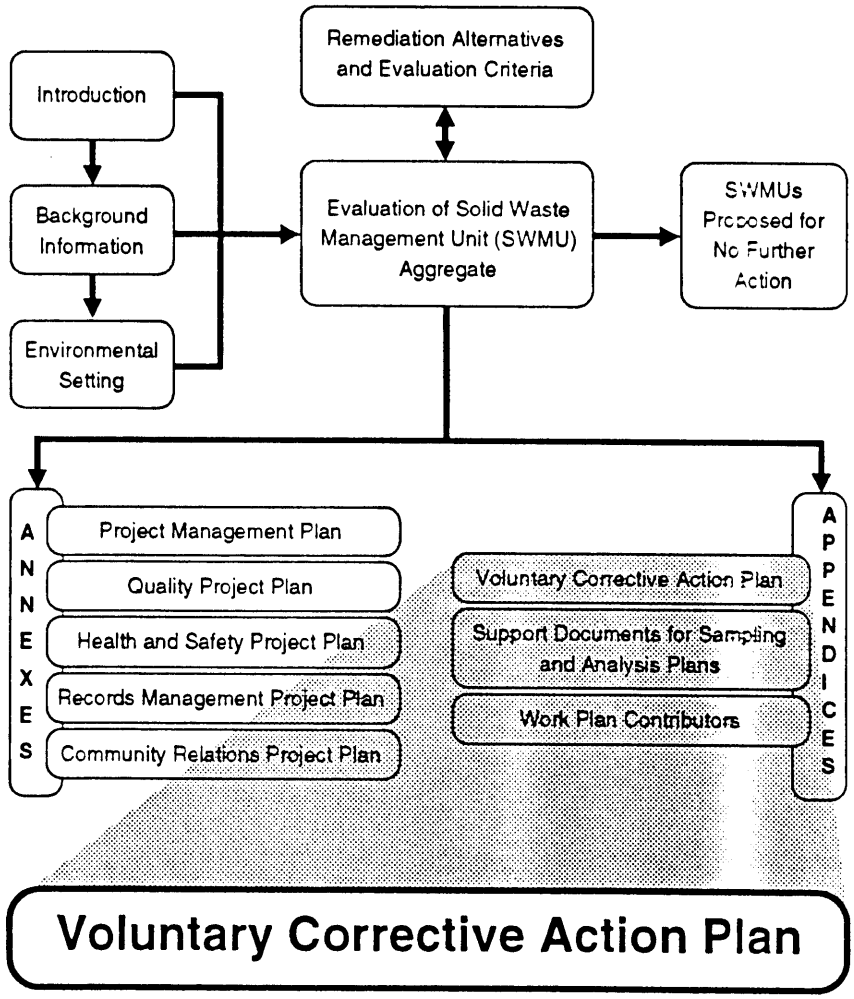
FUTURE ACTION AND PROPOSED TIME FRAME

Future action is focused on further assessment of each SWMU in the Operable Unit, the determination of the extent of contamination, and selecting the appropriate action from a spectrum of possible remedial alternatives. The alternatives range from long-term monitoring and institutional controls to excavation and disposal of contaminants and contaminated soils and restoration. The Hazardous and Solid Waste Amendments (HSWA) module of the Laboratory's Resource Conservation and Recovery Act (RCRA) operating permit specifies the sequence of events by which contaminated areas are identified, characterized, and remediated. The RCRA Facility Investigation (RFI) work plan that describes the characterization activities is being developed and is scheduled to be completed by May 1992. RFI characterization activities are scheduled to be initiated in 1992 and completed in 1998. This site investigation will define the type and extent of any contamination and identify any potential receptors. The Corrective Measures Study (CMS), which develops the set of remediation alternatives, is scheduled to begin in 1999 and be completed in 2001. The CMS is integrated with New Mexico Envrionmental Department closure plans for permitted units in the operable unit.

Ensuring the safe management of past, present, and future waste requires the cooperation of government, industry, and the public. The Laboratory's commitment is to provide information to the public, such as this fact sheet, concerning actions taken during investigation and throughout the entire cleanup process. If you have additional questions about Operable Unit 1148 or about the Laboratory's Environmental Restoration Program, please do not hesitate to visit, call, or write:

Community Relations Project Leader
Environmental Restoration Program
Los Alamos National Laboratory
Box 1663, MS M314
2101 Trinity Drive, Suite 20
Los Alamos, NM 87545
505-665-2127

APPENDIX A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1.0 VOLUNTARY CORRECTIVE ACTION PLAN, INTRODUCTION

To mitigate the effects of the known organic vapor plume (OVP) emanating from the disposal pits, shafts, and surface impoundments at Material Disposal Area (MDA) L (SWMU 54-006), Los Alamos National Laboratory (the Laboratory) has developed the following voluntary corrective action plan (VCAP). The VCAP includes a description of the site, a summary of pertinent data from previous investigations, an outline of additional data needs, and a description of the corrective action proposed.

This VCAP has been prepared to be consistent with the intent of the Environmental Protection Agency's (EPA) Proposed Corrective Action Rule for Solid Waste Management Units (SWMUs) (proposed Subpart S in 40 CFR, Part 264), which encourages voluntary corrective actions by treatment, storage, and disposal (TSD) facilities.

1.1 Background

MDA L is primarily an inactive chemical waste disposal facility with active treatment and storage facilities. Organic vapors emanating from disposal units, pits, shafts, and/or surface impoundments at MDA L have migrated into the adjacent and underlying unsaturated zone. The resulting organic vapor plume (OVP) has migrated from the MDA outward in the subsurface.

The OVP at MDA L is monitored on a quarterly basis and is not presently a threat to human health or the environment. MDA L will remain under institutional control for the foreseeable future. Land surrounding the MDA is currently under DOE control. However, future land use includes a scenario for management by Bandelier National Monument. Under this scenario, the general public may have access to the land for recreation. Remediation of the plume is proposed as a proactive step to remediate any future potential release of the OVP to the atmosphere at concentrations that exceed health risk based concentration or any future potential for deep migration of the OVP to the regional aquifer that is used for water supply.

1.2 Objectives

This VCAP provides the New Mexico Environment Department (NMED) and the EPA with a description of proposed activities and how these activities interrelate to accomplish the objectives of the corrective action. Specific objectives of the VCAP are as follows:

- summarize and evaluate existing information concerning the site and identify additional data needs;
- evaluate potential remedial approaches for the site;
- present a description of the remedial approach selected for the site;

- prepare a cost estimate for implementation of the proposed corrective action; and
- establish a schedule for implementation of the proposed corrective action.

1.3 Technical Approach

A thorough understanding of the process of vapor- and free-phase contaminant transport must be achieved prior to selection and implementation of an appropriate corrective action for the site. To this end, an initial review of available data and literature pertinent to subsurface conditions at the site has been conducted, and data gaps identified. Based on this initial evaluation of site conditions (see Section 2.0) and corrective action objectives (see Section 3.0), potential corrective measures have been evaluated and a tentative corrective action strategy specified (see Section 4.0).

Additional field investigations will be conducted to fill data gaps identified during the initial evaluation. Data collected during these investigations will be used to reevaluate and update the corrective measure selected. The updated corrective measure will be submitted for approval by NMED as a voluntary corrective action.

1.4 VCAP Organization

The remainder of the VCAP is organized as follows:

- Section 2.0 Initial Evaluation of Existing Data and Identification of Data Gaps,
- Section 3.0 Corrective Action Objectives,
- Section 4.0 Preliminary Screening of Corrective Measure Alternatives,
- Section 5.0 Evaluation of Selected Corrective Measure,
- Section 6.0 Cost Estimate,
- Section 7.0 Schedule for Implementation, and
- Section 8.0 Pilot Test Sampling and Analysis Plan.

2.0 INITIAL EVALUATION OF EXISTING DATA

This section summarizes the current understanding of conditions in the vicinity of MDA L. It includes descriptions of the site and associated waste disposal practices, a summary of existing geologic and hydrologic data from previous investigations, a discussion of potential contaminant transport pathways, and a summary of the inferred character and distribution of the contaminant plume(s). The evaluation and interpretation contained in this section are based on the following sources of information:

IT Corporation 1987. "Hydrogeologic Assessment Report - Technical Area 54, Areas G and L, Los Alamos National Laboratory," Los Alamos, New Mexico. (IT Corporation 1987, 0327)

IT Corporation 1991. "Review of Soil Vapor Sampling Wells and Data from TA-54 - MDAs G and L, Los Alamos National Laboratory," (draft) Los Alamos, New Mexico. (IT Corporation 1991, 08-0035).

2.1 Site Description and Waste Disposal History

MDA L is located on Mesita del Buey within the northwest portion of Technical Area 54 (Figure A-1). The MDA is located west of Mesita del Buey Road, approximately 2,000 ft northwest of MDA G, and covers approximately 2.5 acres. Surface elevations at the site range from approximately 6,797 to 6,772 ft above mean sea level (msl).

Mesita del Buey is a narrow, northwest-southeast trending mesa bounded by Canada del Buey on the northeast and Pajarito Canyon on the southwest. The top of the mesa ranges from about 300 to 500 ft in width in the vicinity of MDA L and slopes gently toward the southeast. The sides of the mesa are generally steep, with an average vertical relief of approximately 100 ft (IT Corporation 1987, 0327).

MDA L was used as the primary chemical waste disposal facility at the Laboratory between 1964 and 1985. The locations of waste disposal units within MDA L are shown in Figure A-2 and Figure A-3. From the late 1950s to 1975, all wastes were disposed of in a large pit (pit A) located in the east part of the site. In 1975, pit A was covered, and until 1985, various disposal units, including surface impoundments, and shafts were used for disposal of chemical wastes. The disposal shafts range from 3 to 8 ft in diameter and most are approximately 60 ft deep (IT Corporation 1987, 0327). Table A-1 shows the types of wastes known to have been disposed of at MDA L between 1980 and 1985. In addition to the wastes shown in Table A-1, radioactive lead stringers are held in two storage shafts at MDA L. For a more comprehensive review of the materials disposed of at MDA L, see Section 5.3, MDA L, of this RFI work plan.

2.2 Geology and Hydrogeology

Between 1985 and 1986, approximately 40 groundwater and vadose zone monitoring wells were installed as part of various subsurface investigations in the vicinity of TA-54 (IT Corporation 1987, 0327). Well locations are shown in Figure A-2. Geologic and hydrogeologic data from these investigations pertinent to MDA L are summarized below.

2.2.1 Geologic Setting

MDA L is underlain by a series of sedimentary and volcanic extrusive rocks ranging in age from Miocene to Pleistocene. These rocks attain a thickness of at least 3,500 ft beneath the site and include four main stratigraphic formations from youngest to oldest: the Bandelier Tuff, the Chino Mesa Basalt, the Puye Formation, and the

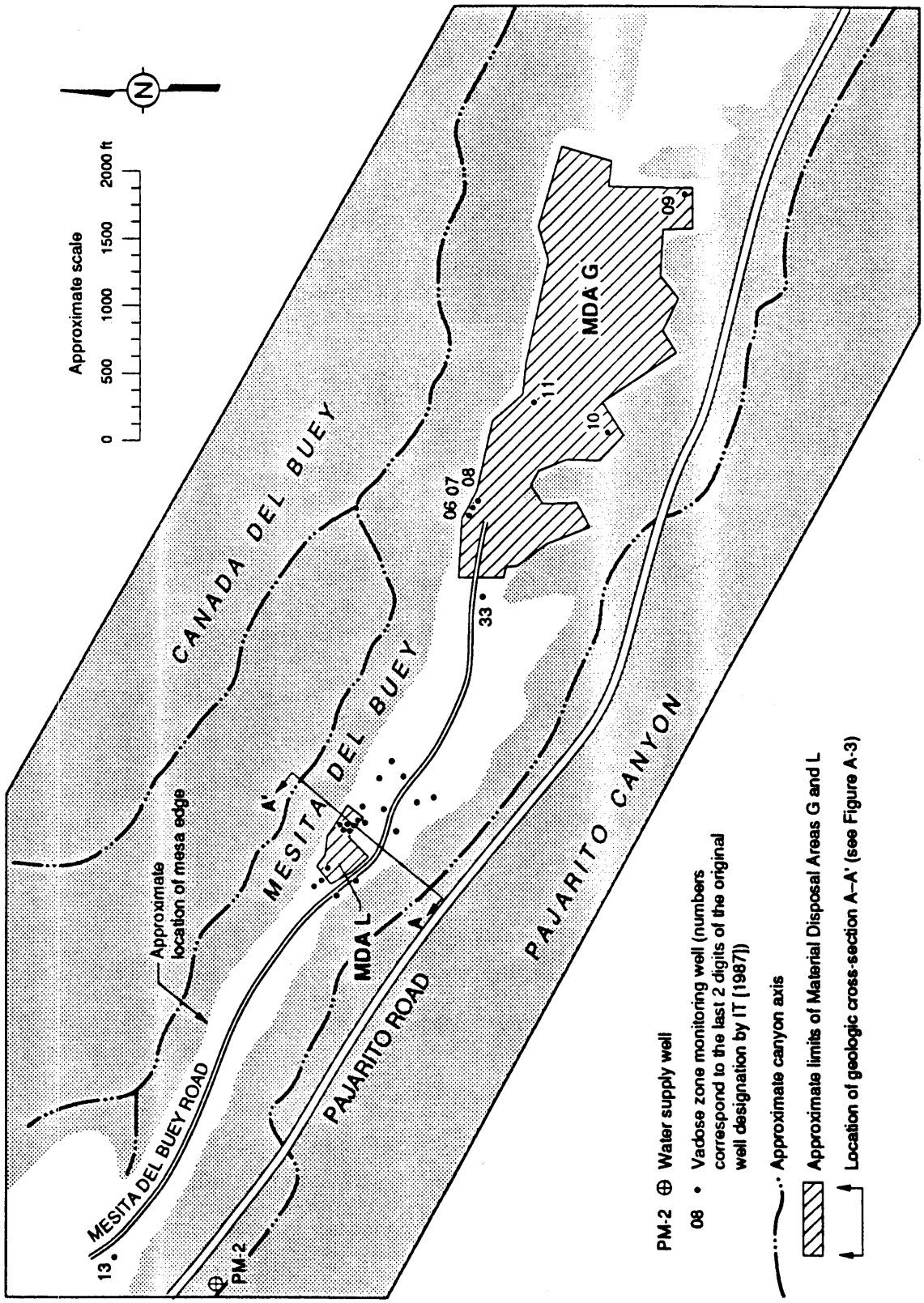

Figure A-1 Location of Technical Area 54.

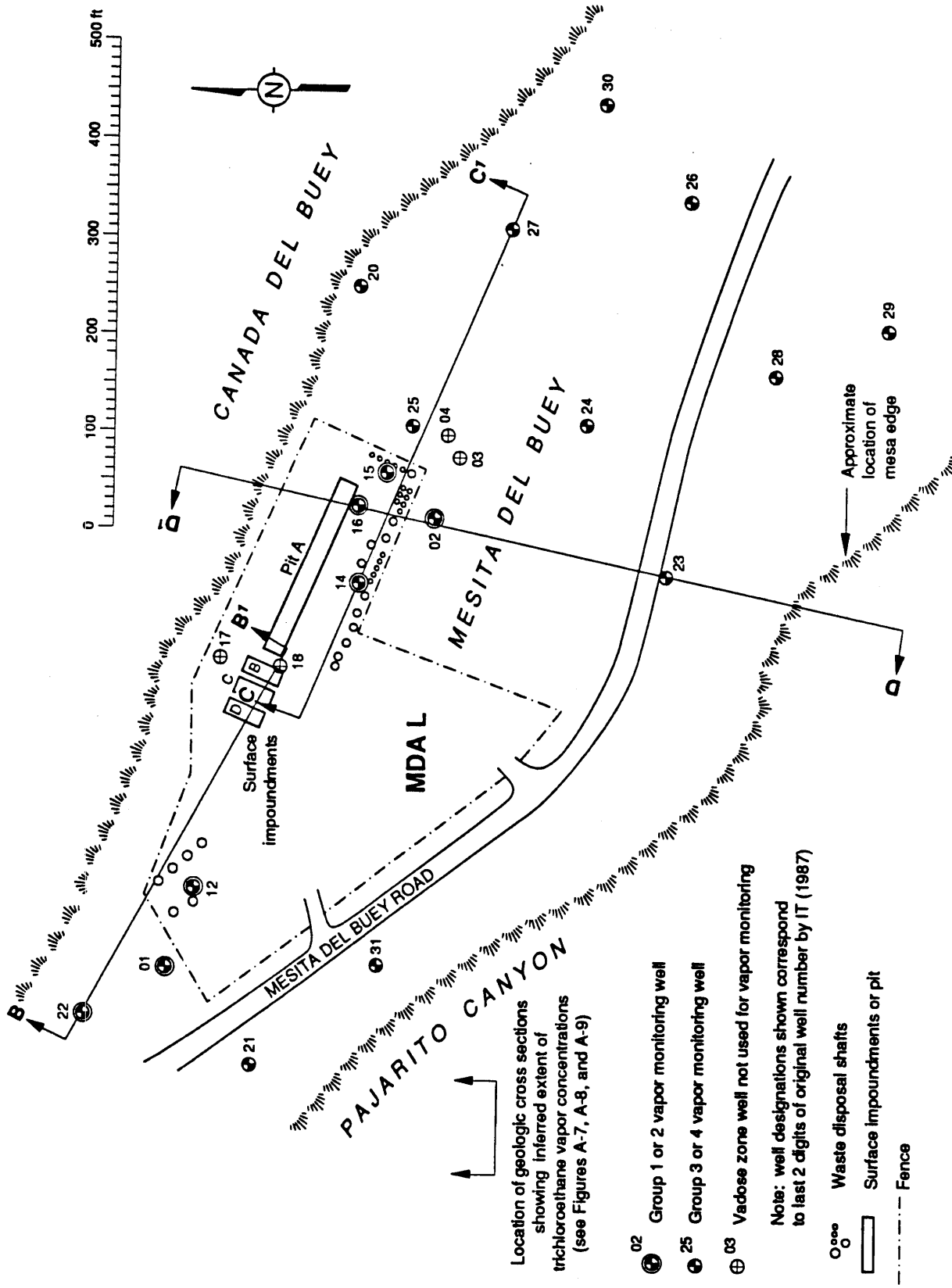

Figure A-2 Site plan for MDA L. (Base map modified from IT Corp. 1987 and 1991; well locations are approximate.)

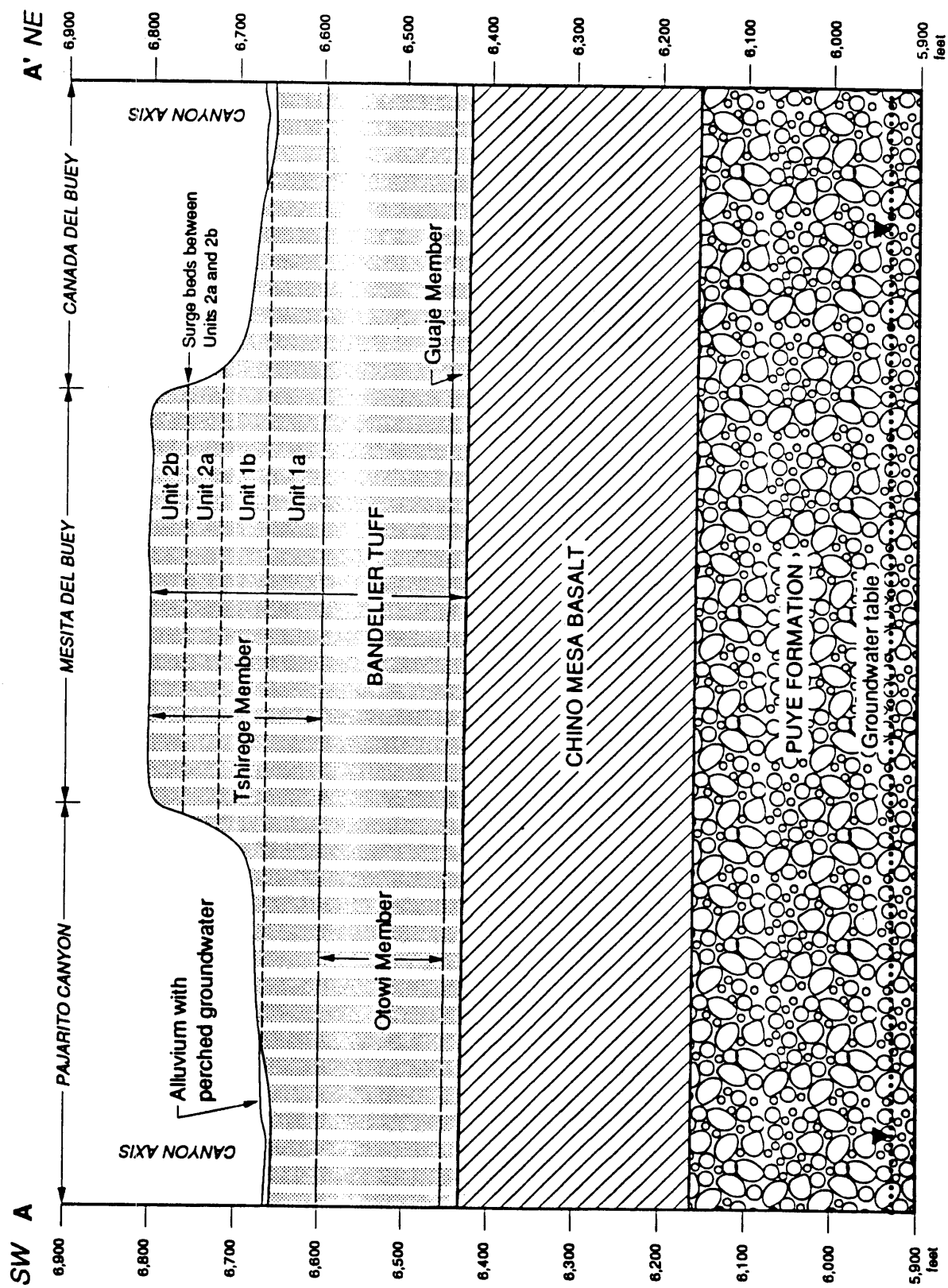

Figure A-3 Generalized geologic cross section A—A' showing inferred distribution of unsaturated lithologic units. (Line of section shown on Figure A-1).

TABLE A-1
SUMMARY OF TYPICAL WASTES DISPOSED OF AT MATERIAL DISPOSAL MDA L*

Aluminum chloride	Ammonia etchant
Ammonia	Ammonium bifluoride
Arsenic contaminated articles	Asbestos
Batteries	Beryllium oxide
Boric acid	Chromic acid
Copier fluid	Corrosive liquid
Cutting oil	Detergent
Dielectric fluid	Diesel Fuel
Dye	Gas cylinders (F_2, HF_2, CL_2)
Epoxy	Ethanol
Ethylene glycol	Freon (1,1,1,2-trichlorofluoroethane)
Fume Litharge	Hydrogen chloride
Hydraulic oil	Inorganics
Kerosene	Laser cell with osmium tetroxide
Lead Chips	Low PCB oil
Mercury with high explosives	Methanol
Methylene chloride	Methyl ethyl ketone
Na-K contaminated materials	Organics, organic chemicals
Organic solvents	Organic solvent with kerosene base
Paint	Paint thinner
Perchloric acid	Photochemical wastes
Photo developer/stripper	Picric acid
2-Propanol	Resins
Sludge with PCB	Soda lime
Stoddard solvent	Surfactant
Transformer oil	Trichloroethane
1,1,1-trichloroethane	Trichloromethane
Unknown waste powder	Waste oil
Weed killer	

*Benchmark 1991, 080023

Tesuque Formation. The general stratigraphy of unsaturated units beneath MDA L is illustrated in Figure A-3.

The Bandelier Tuff is the uppermost formation at TA-54 (Figure A-3), and consists of three units: the Tshirege, Otowi, and Guaje members. These members have an estimated combined thickness of 370 ft beneath MDA L. The uppermost member, the Tshirege, consists primarily of slightly to moderately welded tuff and forms the sides and top of Mesita del Buey. It is approximately 200 ft thick and contains four subunits (1a, 1b, 2a, and 2b) which are differentiated in the field by slight changes in color, degree of welding, and/or percentage of pumice or rock fragments. Numerous subvertical fractures were encountered within the Bandelier Tuff during previous drilling operations. The fractures range up to 2 in. in width, are either open or filled (typically clay), and generally exhibit spacing intervals between 3 and 6 ft (IT Corporation 1987, 0327).

Of particular interest in the Bandelier Tuff are the surge beds at the contact between tuff units 2a and 2b beneath MDA L at TA-54. The surge beds of the Bandelier Tuff are non-welded, laterally persistent pyroclastic beds containing tuff fragments and pumice fragments. The surge beds have a significantly higher lateral permeability than the over-and underlying tuff. For more detailed information, refer to Section 3.5 of this RFI work plan.

The Otowi and Guaje members consist predominantly of nonwelded tuff and pumice, respectively, and are thought to have a combined thickness of approximately 170 ft beneath MDA L. The Chino Mesa Basalt, the Guaje Formation, and the Tesuque Formation occur below the anticipated depth of vapor-phase contamination and are therefore not described in further detail.

2.2.2 Hydrogeologic Setting

2.2.2.1 Unsaturated Zone

In 1985 and 1986, a variety of tests were conducted to evaluate hydrologic characteristics of the unsaturated zone beneath MDA L (IT Corporation 1987, 0327). A summary of the test results is presented in Table A-2. Complete test results can be found in the IT Corporation report (1987, 0327). In general, rocks of the Bandelier Tuff exhibit high porosity, very low moisture content, and very high moisture retention values. Results of *in situ* and laboratory tests indicate relatively moderate values of intrinsic permeability and hydraulic conductivity. Intrinsic permeability is greater than 10^{-10} cm^2 which indicates that a vapor extraction system is a feasible method for corrective action.

2.2.2.2 Saturated Zone

Based on previous investigations at and near the site, first groundwater occurs within the Puye Formation at a depth of approximately 850 to 1,100 ft below grade (Figure A-3). Shallow perched groundwater occurs within alluvium along the axis of Pajarito

TABLE A-2
SUMMARY OF AVERAGE VALUES FOR VADOSE ZONE TEST RESULTS

PARAMETER	AVERAGE VALUE
POROSITY (approximate)	50 %
MOISTURE CONTENT (percent)	2 to 5 %
INTRINSIC PERMEABILITY (cm^2)	
Vacuum Testing	
- Fractured Intervals	1.8×10^{-8}
- Non-Fractured Intervals	1.6×10^{-8}
- All Intervals	1.6×10^{-8}
Air Injection Testing	
- All Intervals	3.1×10^{-8}
Core Sample Analyses	
- Linkenberg Method	4.6×10^{-8}
- Dynamic Method	2.3×10^{-8}
HYDRAULIC CONDUCTIVITY (cm/s)	
Air Injection Testing	
- Fractured Intervals	1.0×10^{-3}
- Non-Fractured Intervals	3.7×10^{-4}
- All Intervals	5.8×10^{-4}
Water Injection Testing	
- All Intervals	7.6×10^{-4}
MOISTURE FLUX (cm/year)	
- Downward - 15.48	
- Upward - 12.10	
- Mean - 2.13	

Canyon (Figure A-3). However, the perched groundwater is apparently confined to the alluvial deposits and does not extend beneath Mesita del Buey (IT Corporation 1987, 0327).

2.3 Contaminant Transport Mechanisms

Given the relatively widespread distribution of organic contamination in the vicinity of MDA L and the lack of evidence for significant liquid-phase or aqueous-phase transport (see below), contaminant migration is thought to occur primarily by vapor-phase transport (IT Corporation 1987, 0327). The mode of transport, whether along laterally persistent surge bed deposits, or along interconnected subvertical fractures, is not clear at this time. The characteristics of the Bandelier Tuff with regard to migration pathways is discussed in Section 3.5.2 of the OU 1148 RFI Work Plan. Results of *in situ* testing of intrinsic permeability conducted in 1985 and 1986 indicated similar values for both fractured and unfractured intervals (IT Corporation 1987, 0327). These tests were limited to nonvertical fractures encountered in borings and may not reflect characteristics of any vertical fractures which may be present at the site.

Previous evaluation of unsaturated zone characteristics (see Section 2.2.2.1) and waste disposal practices (see Section 2.1) at MDA L indicate that limited potential exists for significant migration of liquid wastes or meteoric water containing aqueous-phase contaminants (IT Corporation 1987, 0327). According to IT (IT Corporation 1987, 0327), the amounts of liquid waste disposed of at MDA L are insufficient to result in significant migration of liquid wastes within the unsaturated zone. Based on vertical moisture profiles determined from neutron moisture logging, and relatively high evapotranspiration rates at MDA L, transport of aqueous-phase contaminants by percolating meteoric waters is not expected to be a significant factor below a depth of approximately 20 ft (IT Corporation 1987, 0327).

2.4 Inferred Contaminant Character and Distribution

The chemical compounds detected in soil gas samples at MDA L are organic solvents. The types of detected compounds and their physico-chemical properties are indicated in Table A-3. Under normal conditions of room temperature and atmospheric pressure, these compounds are liquids with relatively high vapor pressures, and thus occur as liquids as well as vapors. The water solubilities of these compounds also indicate that a significant amount of these chemicals could occur as dissolved (aqueous) phases. Saturated vapor pressures of compounds greater than 0.5 torr indicate that vapor extraction is a feasible method for corrective action.

From the current limited soil and groundwater chemistry data, significant migration of liquid wastes and/or aqueous phase contaminants is not believed to have occurred

TABLE A-3
PHYSICAL PROPERTIES AND ACTION LEVELS FOR SELECTED REGULATED VOLATILE ORGANIC COMPOUNDS

COMPOUND (1)	CAS ID NUMBER (2)	VAPOR PRESSURE (mm @ 20 °C) (2)	VAPOR DENSITY (g/L @ 25°C) (2)	HENRY'S LAW CONSTANT (atm·m3/mol) (2)	SOLUBILITY IN WATER (mg/L @ 25°C)(2)	PEL (Air) (mg/m3) (2)	SUBPART S ACTION LEVEL (air) (mg/m3)(3)	SUBPART S ACTION LEVEL (soil) (mg/kg) (3)
Acetone	67-64-1	180	2.37	.0000397	Miscible	~2,350	NL	8,000
Benzene	**71-43-2**	**76**	**3.19**	**.005**	**1,780**	**~30**	**NL**	**NL**
Bromodichloromethane (a)	75-27-4	50	6.70	.0024	4,500 @ 0°C	NL	NL	.5
Bromoform	75-25-2	4	10.33	.00056	3,010	~5	NL	2,000
Bromomethane	74-83-9	1,824 @ 25°C	3.88	.20	900	~40	30	100
2-Butanone (methyl ethyl ketone)	78-93-3	77.5	2.94	.0000466	353,000 @ 10°C	~590	300	4,000
Carbon disulfide	75-15-0	297.5	3.11	.0133	2,000	20 ppm	NL	8,000
Carbon tetrachloride (a)	**56-23-5**	**90**	**6.29**	**.030**	**800**	**10 ppm**	**.03**	**5**
Chlorobenzene	**108-90-7**	**9**	**4.60**	**.0036**	**500**	**~350**	**20**	**2,000**
Chloroethane	75-00-3	1,011	2.76 kg/m3 @ 20°C	.0111	5,740	~2,600	NL	NL
2-Chloroethyl vinyl ether	110-75-8	26.75	4.36	.00025	15,000	NL	NL	NL
Chloroform (a)	**67-66-3**	**160**	**4.88**	**.003**	**8,200**	**~240**	**.04**	**100**
Chloromethane	74-87-3	3,789	2.06	.00882	7,250	~205	NL	NL
Dibromochloromethane	124-48-1	76	8.51	.00099	4,000	NL	NL	NL
1,1 Dichloroethane	75-34-3	182.1	4.04	.0043	5,500	~400	NL	NL
1,2 Dichloroethane (a)	107-06-2	64	4.04	.00091	8,690	50 ppm	.04	8
1,1 Dichloroethene (a)	75-35-4	495	3.96	.021	400	~20	.03	10
Trans-1,2 Dichloroethene	156-60-5	265	3.96	.00674	600	NL	NL	NL
1,2 Dichloropropane	78-87-5	42	4.62	.0023	2,700	~350	NL	NL
Cis-1,3-dichloropropene (a)	10061-01-5	25	4.54	.0013	2,700	NL	NL	20
Trans-1,3 dichloropropene	10061-02-6	25	4.54	.0013	2,800	NL	NL	20
Ethylbenzene	**100-41-4**	**7.08**	**4.34**	**.0066**	**152**	**~435**	**NL**	**8,000**

TABLE A-3, Continued
PHYSICAL PROPERTIES AND ACTION LEVELS FOR SELECTED REGULATED VOLATILE ORGANIC COMPOUNDS

COMPOUND (1)	CAS ID NUMBER (2)	VAPOR PRESSURE (mm @ 20 °C) (2)	VAPOR DENSITY (g/L @ 25°C) (2)	HENRY'S LAW CONSTANT (atm·m3/mol) (2)	SOLUBILITY IN WATER (mg/L @ 25°C)(2)	PEL (Air) (mg/m3) (2)	SUBPART S ACTION LEVEL (air) (mg/m3)(3)	SUBPART S ACTION LEVEL (soil) (mg/kg) (3)
2-Hexanone	591-78-6	2	4.09	.00175	34,400 @ 25°C	~400	NL	NL
4-Methyl, 2-pentanone (methyl isobutyl ketone)	108-10-1	15	4.09	.0000149	17,000	~410	70	4,000
Methylene Chloride (a)	75-09-2	348.9	3.47	.0020	20,000	500 ppm	.3	90
Styrene (a)	100-42-5	5	4.26	.00261	300	100 ppm	NL	20,000
1,1,2,2 Tetrachloroethane (a)	79-34-5	5	6.86	.00038	2,900	~35	.2	40
Tetrachloroethene (a)	**127-18-4**	**14**	**6.78**	**.015**	**150**	**100 ppm**	**1**	**10**
Toluene	**108-88-3**	**22**	**3.77**	**.0067**	**515**	**~375**	**7,000**	**20,000**
1,1,1 Trichloroethane	**71-55-6**	**100**	**5.45**	**.018**	**1,360**	**~1,900**	**1,000**	**7,000**
1,1,2 Trichloroethane (a)	79-00-5	19	5.45	.00074	4,500	~45	.6	100
Trichloroethene (a)	**79-01-6**	**57.8**	**5.37**	**.009**	**1,100**	**~270**	**NL**	**60**
Vinyl acetate	108-05-4	83	3.52	.000481	20,000	~30	NL	NL
Vinyl chloride	75-01-4	2,580	2.55	2.78	1,100 @ 25°C	1 ppm	NL	NL
o-Xylene	**95-47-6**	**6.6 @ 25°C**	**4.34**	**.005**	**152**	**~435**	**1,000 (b)**	**200,000 (b)**

FOOTNOTES:

Bold. Compounds previously detected in soil gas in MDA L.

a. Listed as a carcinogen in Appendix A, Proposed Subpart S, 40 CFR, Part 264.

b. Reference for mixed xylenes.

NL. Not listed.

REFERENCES:

1. Flotard, R.D., M. T. Homshen, J. S. Wolff and J. M. Moore. 1986. Volatile Organic Analytical Methods Performance and Quality Control Con-siderations. In: Quality Control in Remedial Site Investigation: Hazardous and Industrial Solid Waste Testing, Fifth Volume ASTM STP 925.

2. "Groundwater Chemicals Desk Reference", John H. Montgomery and Linda M. Welkom, Lewis Publishers, Chelsea Michigan, 1990.

3. Appendix A, Proposed Subpart S, Part 264, 40 CFR, in "Federal Register 55", 30798, July 27, 1990.

at the site (Section 2.3). The contamination in the vicinity of MDA L appears to result primarily from the migration of a vapor-phase plume, although it is likely that residual liquid wastes, trapped within rock fractures by capillary tension, occur near the source of contamination. A summary of information concerning the inferred character and distribution of the vapor-phase beneath MDA L is presented in the following section. Potential residual liquid phase contamination, and adsorption of contaminants on the soil/rock matrix are discussed in Section 2.4.2.

2.4.1 Vapor Contaminant Plume

2.4.1.1 Vapor Monitoring Well Locations and Design

Figure A-2 shows the locations of 18 monitoring wells in the vicinity of MDA L which are regularly monitored for volatile organic vapors. These wells have depths ranging from 100 to 288 ft. Well depths and characteristics are summarized in sections 5.3.4.4 and 5.4.4.4.

2.4.1.2 Vapor Constituents

Table A-4 lists the maximum and average concentration of organic compounds detected in soil gas samples from wells near MDA L. Concentrations in soil samples, and action levels for ambient air and soil are also indicated in Table A-4 for reference only. 1,1,1-trichloroethane (TCA) appears to be the dominant vapor-phase contaminant beneath the site, followed by chloroform, trichloroethene (TCE), and tetrachloroethene (PCE). Besides organic compounds, there has been speculation that radioactive constituents could be present in soil vapors in the vicinity of MDA L.

2.4.1.3 OVP Contaminant Mass

The following basic procedure was used to calculate an estimated mass of contaminants: (1) area polygons for each vapor monitoring well were determined; (2) weighted average contaminant concentrations for each well profile were determined; (3) volume of rock for each well polygon was calculated; and (4) void volume was calculated by utilizing a porosity of 0.5 (IT Corporation 1987, 0327). From these parameters, contaminant mass was calculated for each well polygon by multiplying the volume of the voids by the weighted average concentration for each well polygon. The contarninant mass was then summed over the limits of the MDA L study area.

Based on maximum contaminant concentrations (vapor phase) detected during 1990, the portion of the OVP south and west of MDA L contains an estimated 850 lbs (vapor phase) of volatile organic compounds. TCA comprises the majority of this total mass (659 lbs), followed by TCE (134 lbs), carbon tetrachloride (28.9 lbs), chloroform (14.2 lbs), tetrachloroethylene (7.7 lbs), toluene (3 lbs), and benzene (1.1 lbs). Chlorobenzene, xylenes, and 1,2,4-trimethylbenzene were detected but are each expected to total less than 0.5 lbs.

TABLE A-4
CONSTITUENT CONCENTRATIONS AND ACTION LEVELS

Constituent	Maximum Measured Soil Vapor Concentration (mg/L)[c,b]	Average Soil Vapor Concentration (mg/L)[c,f]	Ambient Air Action Level (mg/L)[f] £	Maximum Measured Soil Concentration (m g/kg)[d]	Soil Action Level (mg/kg)
Ethylbenzene	73.6	0.8	104[b]	£	8,000[a]
Bromobenzene*	6.8	.004	—	£	—
Toluene	935	6.0	7[a]	0.012	20,000[a]
Chlorobenzene	507.8	0.8	.02[a]	£	2,000[a]
Tetrachloroethene	529	5.3	.001[a]	£	10[a]
Chloroform	1,479.2	10.7	.00004[a]	£	100[a]
Benzene	175.8	2.3	7[b]	£	24[a]
1,1,1 Trichloroethane	12,947.7	604.5	1[a]	£	7,000[a]
Trichloroethene	7,142.9	81.8	64[b]	£	60[a]
o-Xylene (as xylenes)	395.0	1.7	1[a]	£	200,000[a]
1,2,4-Trimethylbenzene*	56.7	1.0	—	£	—
Carbon Tetrachloride	757.5	5.4	.00003[a]	£	5[a]
Xylenes	800.8	1.1	1[a]	£	200,000[a]
Acetone	£	£	~560[b]	4.3	8,000[a]
Acetonitrile	£	£	—	1.1	500[a]
1-Butanol	£	£	—	100	8,000[a]
1,4-Dioxane	£	£	—	1.5	60[a]
2-Hexanone*	£	£	~95[b]	4.13	—
Tetrahydrofuran*	£	£	—	4.5	—
Bisoxymethane*	£	£	—	0.27	—
2-Butanone (methyl ethyl ketone)	£	£	0.3[a]	0.47	4,000[a]
Ethanol*	£	£	—	0.19	—
4-Methyl-2 Pentanone (methyl isobutyl ketone)	£	£	.007[a]	0.42	4,000[a]

TABLE A-4, Continued
CONSTITUENT CONCENTRATIONS AND ACTION LEVELS

Constituent	Maximum Measured Soil Vapor Concentration (mg/L)[c,b]	Average Soil Vapor Concentration (mg/L)[c,f]	Ambient Air Action Level (mg/L)[f]	Maximum Measured Soil Concentration (m g/kg)[d]	Soil Action Level (mg/kg)
Propanol*	£	£	—	0.27	—
Chlorodifluoromethane*	£	£	—	0.012	—
1,2-Dichloroethane	£	£	.00004[a]	0.019	8[a]
Dimethoxymethane*	£	£	—	0.025	—
Fluorinated Aliphatics	£	£	NA	0.006	NA
2-Methyl 2-Propanol (isobutyl alcohol)	£	£	—	0.077	20,000[a]
Methylene Chloride	£	£	.3[a]	0.030	90[a]
2-Propanol*	£	£	—	0.006	—
Unknown Hydrocarbons	£	£	NA	0.020	NA
Tetramethyl-pentanone*	£	£	—	0.007	—

FOOTNOTES:

a. Appendix A, Proposed Subpart S, Part 264, 40 CFR, in "Federal Register 55", 30798, July 27, 1990.
b. Calculated from PEL data in "Groundwater Chemicals Desk Reference", John H. Montgomery and Linda M. Welkim, Lewis Publishers, Chelsea, MI, 1990.
c. Calculated from data included in Appendix 3.3-D.
d. Calculated from data (IT Corporation, 1987, 0327).
e. Calculated from toxicity data in "Health Effects Summary Tables, FY-1991 Annual" (EPA 1991, 0658).
f. Concentrations in ppmV can be obtained by dividing the concentrations in m/L by the vapor density of the compound in g/L (see Table 5-3 for densities or assume an average density of 4 g/L)
* Toxicity data not listed in Proposed Subpart S, HEAST or other references consulted.
NA. Not applicable.
£ Non-analyte.

2.4.1.4 Inferred Distribution of OVP

Tables A-5, A-6 and A-7 list the maximum TCA, chloroform, and TCE vapor concentrations detected in each monitoring well during 1990. The estimated lateral extent of these constituents based on the data presented in the tables is shown in Figures A-4, A-5, and A-6 A comparison of Figures A-4, A-5, and A-6 and review of data in Table A-4 suggests that TCA is the most highly concentrated and wide spread of the organic vapor constituents. Therefore, to facilitate discussion of contaminant distribution, TCA has been used to characterize the entire vapor plume. The lateral and/or vertical extent of some or all of the other vapor constituents may be significantly less than that indicated for TCA.

The TCA vapor plume extends approximately 400 ft southeast and at least 125 ft northwest of MDA L (Figure A-4). The upper 100 ft of the plume (approximately) is defined to the southwest and northeast by the sides of Mesita del Buey. Presently, it is not known if the plume intersects the sides of the mesa. Maximum TCA, chloroform, and TCE concentrations from each well located in the vicinity of MDA L are listed in Table A-4.

The vertical extent of the TCA vapor plume is not completely defined by available data (Figures A-7, A-8, and A-9 and Tables A-5, A-6, and A-7). Wells located within MDA L, where the plume is expected to reach its maximum depth, are not of sufficient depth to fully define the vertical limits of the plume. Data from well 02, located just west of the southern waste disposal shaft cluster, indicates that the vapor plume extends at least 200 ft below grade.

Data from wells outside MDA L suggest contaminant concentrations decrease with depth, with the majority of contaminants occurring above a depth of approximately 200 ft below grade.

2.4.2 Adsorbed-Phase Contaminant Plume

The current soil gas data indicate that at several locations, maximum soil vapor concentrations occur at depth below the presumed depth of the waste disposal shafts (60 ft). This indicates that migration of liquids from the shafts to deeper depths could have occurred. For comparison with the measured soil gas concentrations, gas concentrations at equilibrium with pure liquid TCA, TCE, and chloroform were calculated using the vapor pressure and density data in Table A-3. These saturated gas concentrations are approximately 720,000 ug/l for 1,1,1-TCA, 410,000 ug/l for TCE, and 1,000,000 ug/l for chloroform, and thus are much higher than the concentrations observed in the field. The lower field concentrations, however, do not preclude the existence of liquid phases at residual saturation, which would yield diluted soil gas concentrations when compared to saturated values.

The presence of adsorbed-phase contamination is typically evaluated by analyzing representative soil or rock samples. Analyses of core samples collected at the site were reviewed, but the available data were limited. In general, the suite of analyses run on core samples was different from the analytical suite for gas samples. TCA, which appears to be the dominant vapor-phase contaminant at the site, was not

TABLE A-5
SUMMARY OF MAXIMUM 1,1,1-TRICHLOROETHANE VAPOR CONCENTRATIONS (1990 DATA*) FOR GROUP 1 AND GROUP 2 WELLS (MICROGRAMS PER LITER)

Depth Interval Feet	Wells Near Northern Waste Disposal Shafts				Waste Near Southern Waste Disposal Shafts		
	01	12	22	02	14	15	16
0-14	--	2,092	--	--	6,472	--	--
15-30	1,093	3,157	70	1,454	--	3,392	2,631
31-45	931	2,599	185	1,010	7,522	4,979	3,778
46-70	1,232	--	191	1,500	--	--	--
71-90	181	--	142	370	3,180	5,372	6,335
91-110	839	--	55	4,218	--	--	--
111-130	773	--	99	1,104	--	--	--
131-150	548	--	38	1,347	--	--	--
151-170	1,289	--	ND	641	--	--	--
171-190	950	--	ND	1,424	--	--	--
191-210	33	--	ND	873	--	--	--
>210	--	--	--	--	--	--	--

*Data from Appendix B of IT Corporation (1991, 0327)

TABLE A-6
SUMMARY OF MAXIMUM CHLOROFORM VAPOR CONCENTRATIONS (1990 DATA*) FOR GROUP 1 AND GROUP 2 WELLS (MICROGRAMS PER LITER)

Depth Interval	Wells Near Northern Waste Disposal Shafts			Waste Near Southern Waste Disposal Shafts			
	01	12	22	02	14	15	16
0-14	--	ND	--	--	108	--	--
15-30	ND	ND	ND	ND	--	129	41
31-45	ND	16	ND	ND	97	162	83
46-70	ND	--	ND	46	61	--	--
71-90	ND	--	ND	ND	42	277	91
91-110	ND	--	ND	120	--	--	--
111-130	ND	--	ND	37	--	--	--
131-150	--	--	ND	13	--	--	--
151-170	ND	--	ND	ND	--	--	--
171-190	--	--	ND	48	--	--	--
191-210	ND	--	ND	--	--	--	--
>210	--	--	--	--	--	--	--

*Data from Appendix B of IT Corporation (1991, 0327)

TABLE A-7
SUMMARY OF MAXIMUM TRICHLOROETHENE VAPOR CONCENTRATIONS (1990 DATA*) FOR GROUP 1 AND 2 WELLS (MICROGRAMS PER LITER)

Depth Interval (Feet)	Wells Near Northern Waste Disposal Shafts				Waste Near Southern Waste Disposal Shafts		
	01	12	22	02	14	15	16
0-14	--	704	--	--	1,191	--	--
15-30	90	1,128	10	290	1,116	680	580
31-45	140	834	23	304	--	11011	1,087
46-70	108	--	26	382	846	--	--
71-90	148	--	13	56	699	2,419	940
91-110	101	--	19	760	--	--	--
111-130	92	--	21	329	--	--	--
131-150	--	--	12	309	--	--	--
151-170	100	--	ND	133	--	--	--
171-190	45	--	ND	425	--	--	--
191-210	18	--	ND	160	--	--	--
>210	--	--	--		--	--	-- --

*From IT Corporation (1991, 0327).

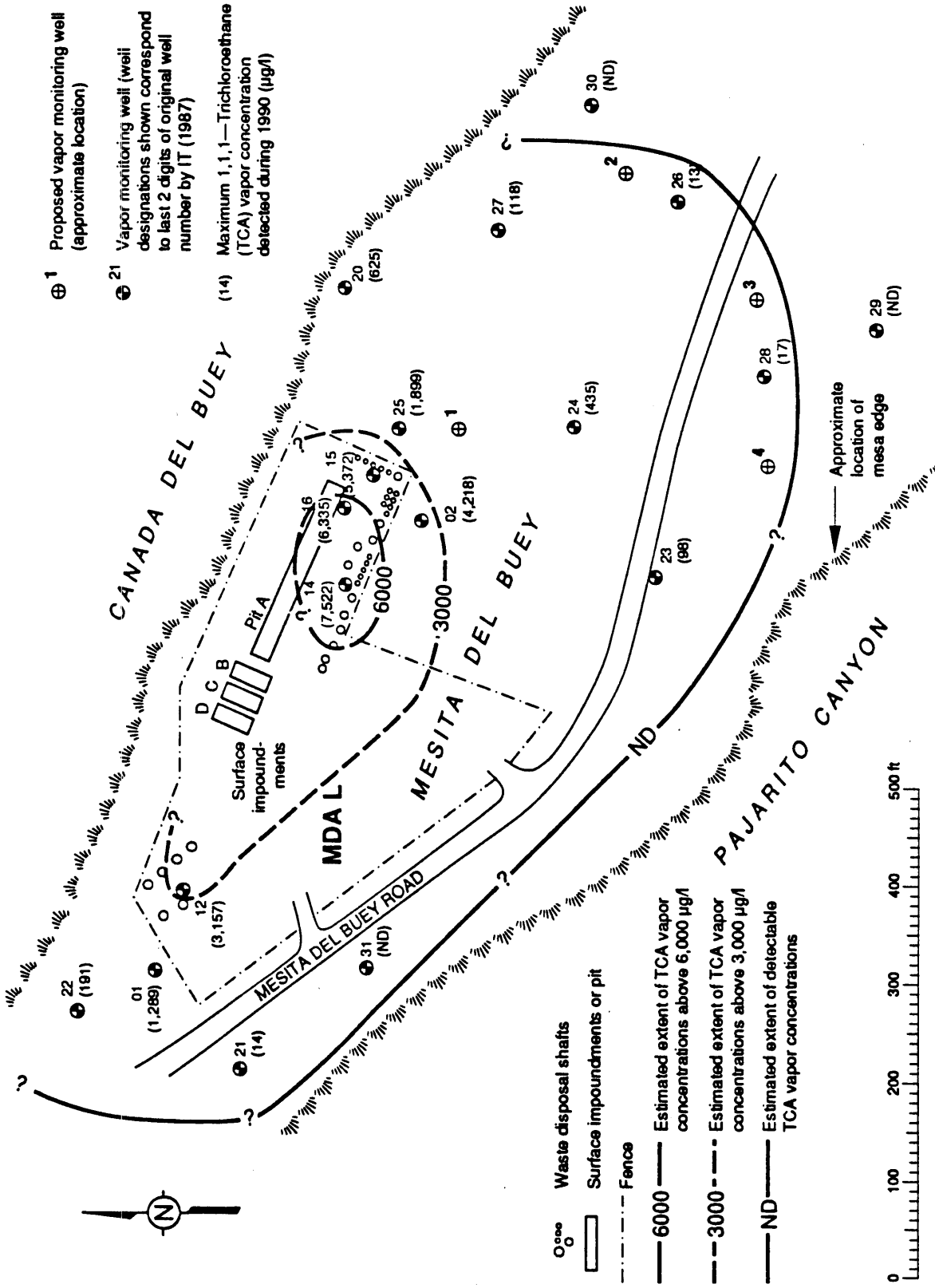

Figure A-4 Approximate extent of vapor plume based on TCA distribution. (Base map modified from IT Corp. 1987 and 1991; well locations are approximate.)

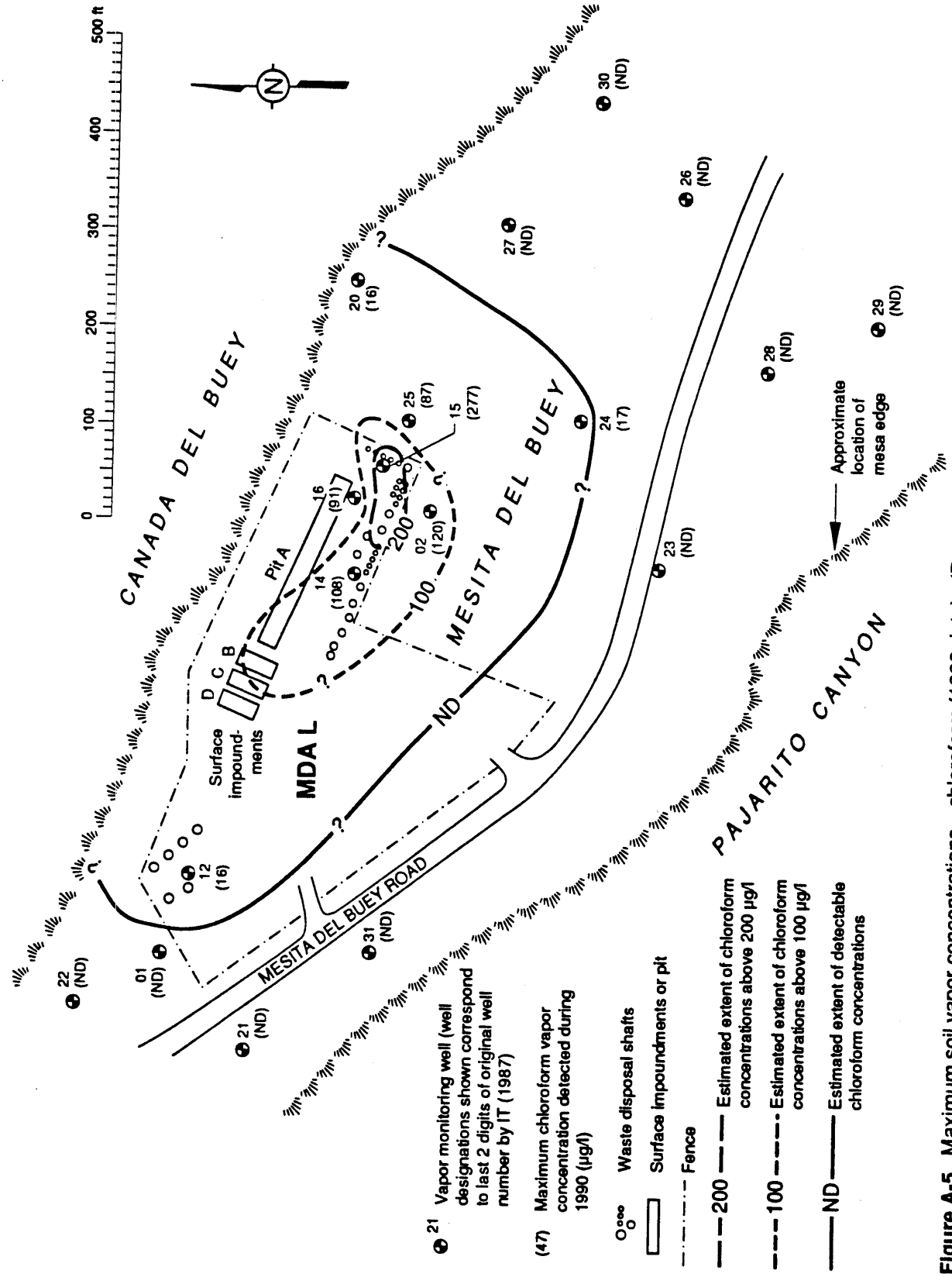

Figure A-5 Maximum soil vapor concentrations—chloroform (1990 data). (Base map modified from IT Corp. 1987 and 1991; well locations are approximate.)

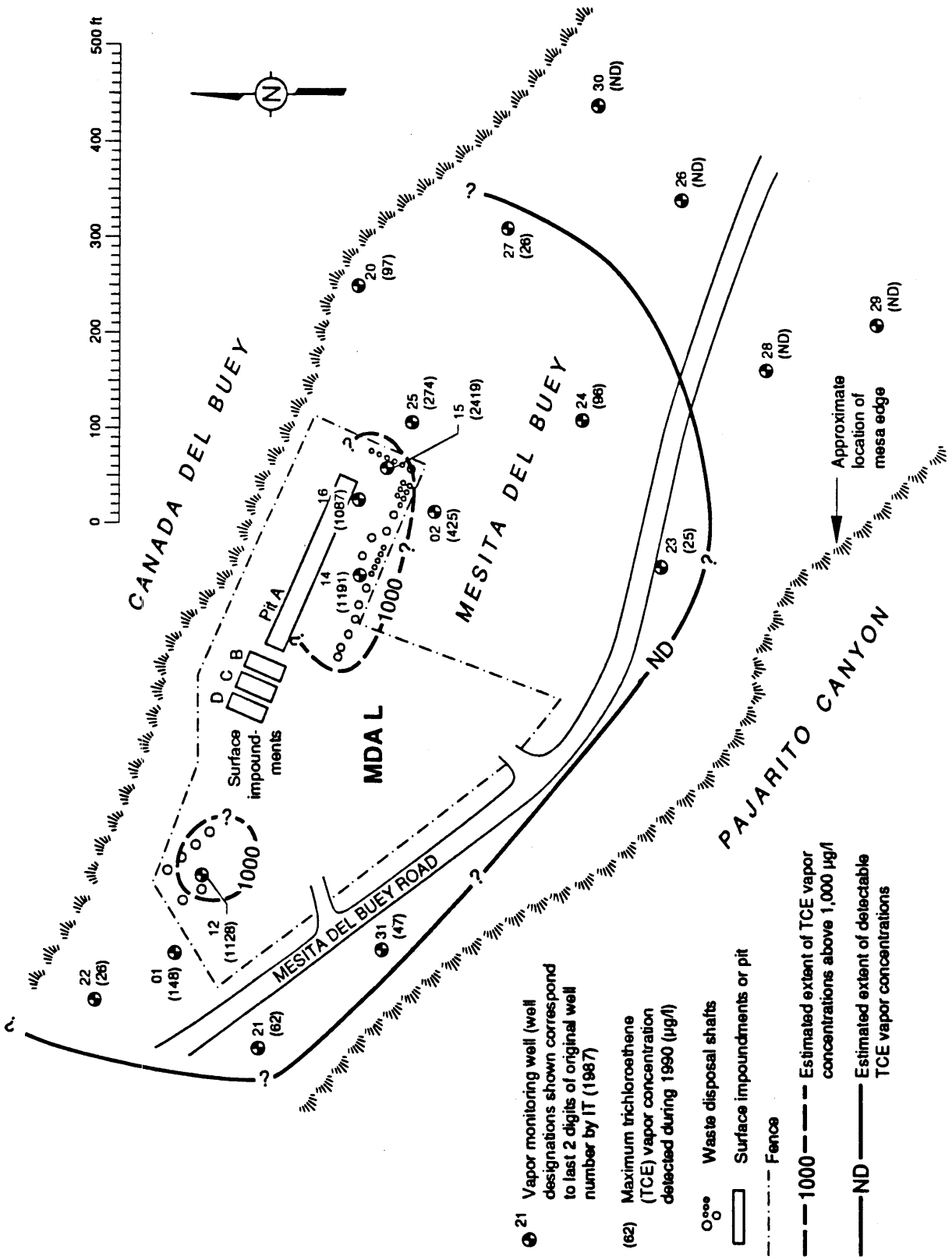

Figure A-6 Maximum soil vapor concentrations—trichloroethene (1990 data). (Base map modified from IT Corp. 1987 and 1991; well locations are approximate.)

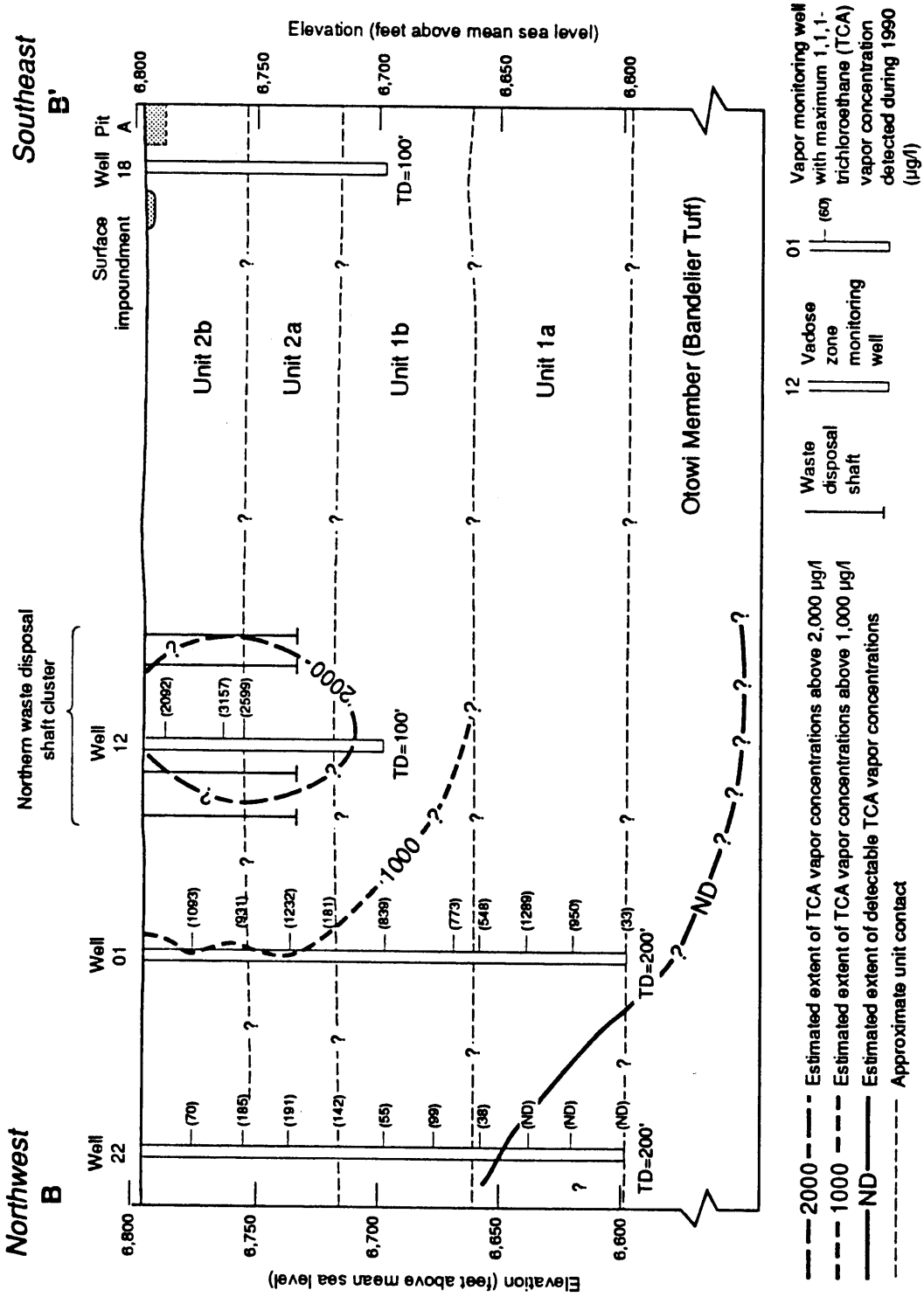

Figure A-7 Generalized geologic cross-section B–B' showing inferred extent of 1,1,1-trichloroethane vapor concentrations.

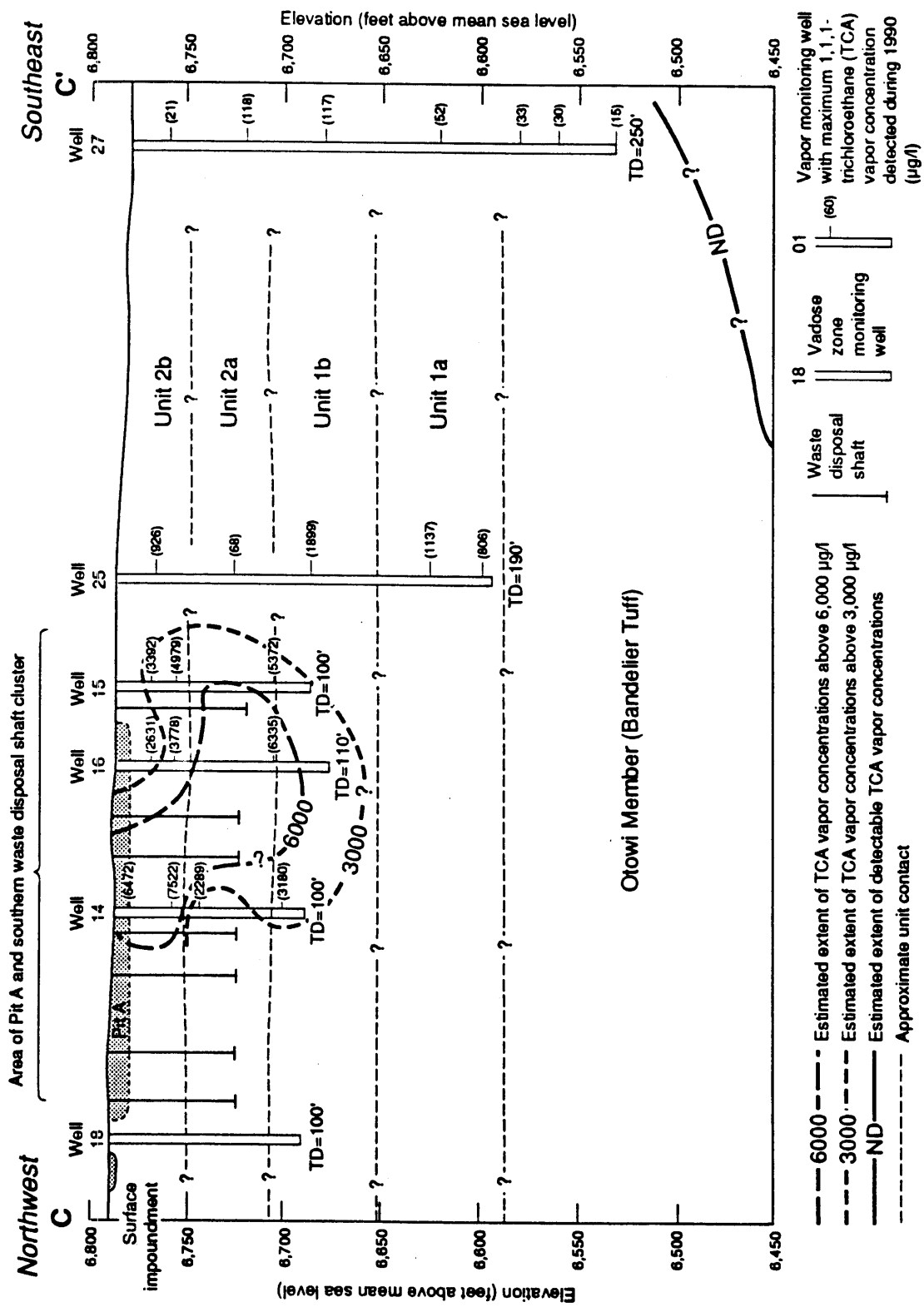

Figure A-8 Generalized geologic cross-section C–C' showing inferred extent of 1,1,1-trichloroethane vapor concentrations.

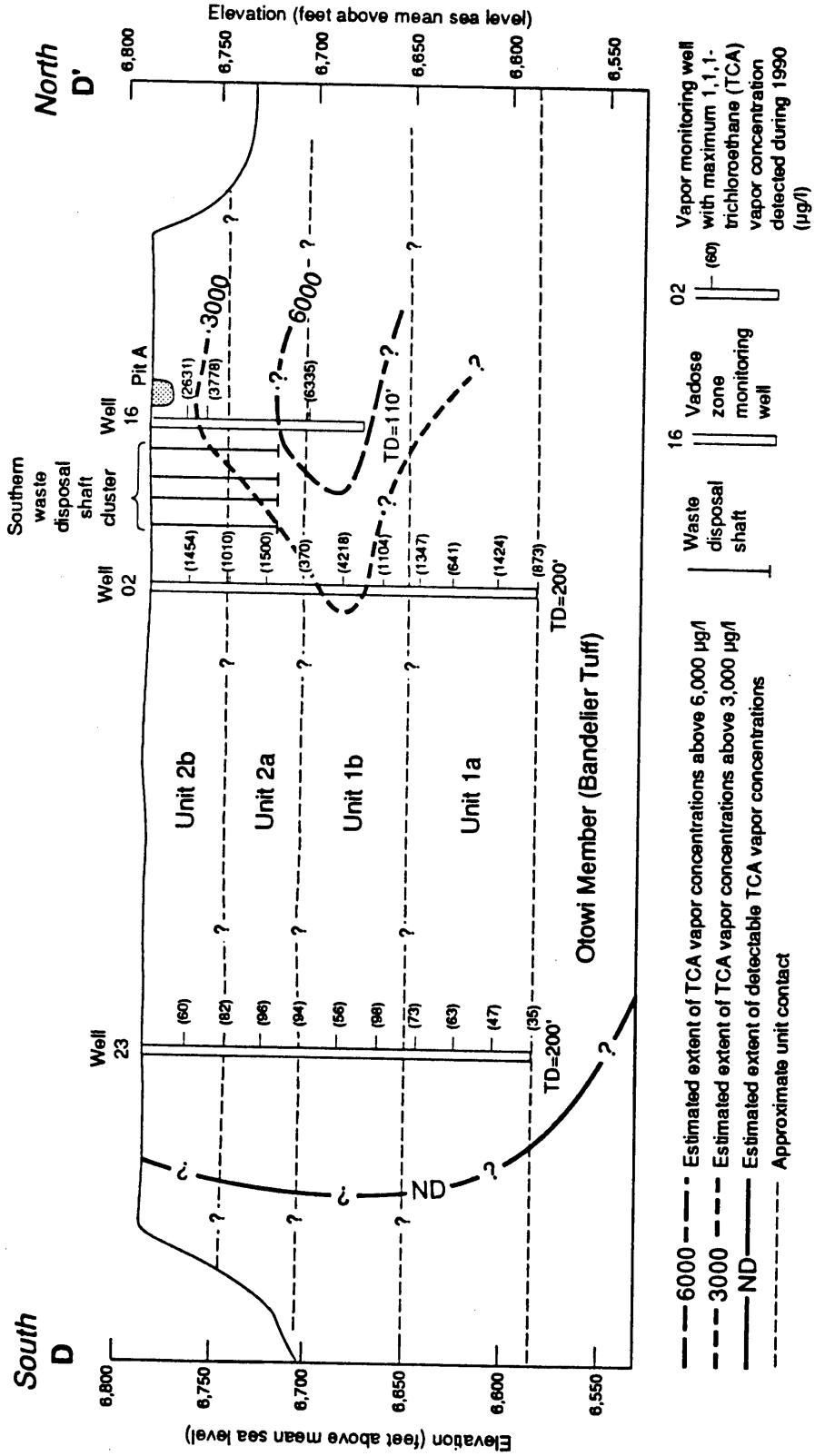

Figure A-9 Generalized geologic cross-section D–D' showing inferred extent of 1,1,1-trichloroethane vapor concentrations.

analyzed in any of the core samples. The maximum vapor concentrations of contaminants detected in vapor monitoring wells located within MDA L are listed in Table A-8. Given the reported limited potential for migration of liquid- or aqueous-phase contaminants (IT Corporation 1987, 0327) and the vapor concentrations detected at the site, residual saturated contamination is not expected to extend much beyond the depth of the disposal impoundments, pits, or shafts.

In summary, the soil gas concentrations measured at the site are in a range that is considered feasible for extraction. The vapor plume occurs within volcanic tuffs which are expected to have mineralogy and physical matrix characteristics which will sorb VOCs. The actual sorbtion properties of the tuff for the VOCs is unknown and bench studies are required to quantitatively determine sorbtion for specific VOCs.

2.4.3 Potential Contaminant Source(s)

The distribution of TCA vapor concentrations (Figure A-4) indicates that the source of the OVP is located within MDA L. Based on available data, the highest TCA concentrations appear to be in the southeastern part of the MDA near the southern waste disposal shaft cluster, the surface impoundments, and pit A. This statement has not been confirmed because there is no data available in areas north of pit A and in areas immediately west of the pit. Based on relatively high TCA vapor concentrations in well 12, a second source for TCA is also present in the northern waste disposal shaft cluster (Figure A-4).

2.5 Data Gaps and Data Quality Objectives

2.5.1 Data Needs

The following sections summarize data gaps identified during the initial evaluation. Discussion is limited to that information necessary for development of a remedial measure for the vapor-phase plume in the vicinity of MDA L. General data quality objectives for the investigation of TA-54 have been identified in Section 5 of this RFI work plan. These general data quality objectives will apply to the data needs listed in the following sections.

2.5.2 Unsaturated Zone Characteristics

- Further investigate migration pathways for vapor-phase contaminants at the site. These pathways include vertical fractures and laterally persistent horizontal surge bed deposits.
- Determine physical properties of the geologic formations in sufficient detail to allow the analysis of the proper placement and spacing of vapor recovery wells.

TABLE A-8
SUMMARY OF MAXIMUM VAPOR CONCENTRATIONS (1990 DATA) FOR VAPOR MONITORING WELLS NEAR MATERIAL DISPOSAL AREA L (MICROGRAMS PER LITER)

Group Number	Well Number	TCA (mg/l)	Chloroform (mg/l)	TCE (mg/l)
1	12	3,157	16	1,128
	14	7,522	108	1,191
	15	5,372	277	2,419
	16	6,335	91	1,087
2	01	1,289	ND	148
	02	4,218	120	425
	22	191	ND	26
3	20	625	16	97
	21	14	ND	62
	23	98	ND	25
	24	435	17	96
4	25	1,899	87	274
	26	13	ND	ND
	27	118	ND	26
	28	17	ND	ND
	29	ND	ND	ND
	30	ND	ND	ND
	31	ND	ND	47

2.5.3 Vapor-Phase Contamination

- Investigate the importance of horizontal, laterally persistent surge beds as a migration pathway for the vapor plume.
- Investigate and confirm the vertical extent of vapor contamination, particularly near Pit A in the vicinity of LLC-85-15 (Figure A-4).
- Construct additional vapor monitoring wells of sufficient depth and design to define the vertical distribution of vapor constituents.
- Confirm presence/absence of tritium in the vapor plume.

2.5.4 Soil/Rock Contamination

- Investigate the lateral and vertical extent of soil/rock contamination in the vicinity of MDA L, particularly directly beneath Pit A, the surface impoundments, and the waste disposal shafts. Remediation of any residual liquid-phase contamination which may be present is not included in the scope of work. However, delineation of this contamination is important in evaluating the potential for future migration of vapor-phase contaminants, in designing the vapor plume remediation system, and in evaluating its effectiveness.
- Evaluate the presence/absence of radioactive waste constituents in soil/rock beneath the site.
- Compare soil/rock contaminant concentrations to specific action levels and evaluate need for remediation.

3.0 CORRECTIVE ACTION OBJECTIVES

The corrective measure will be designed to control and remediate the OVP emanating from MDA L. The OVP currently is not believed to present a significant risk to human health or the environment. However, the objective of the corrective measure will be to minimize the potential for future contamination of air, surface water or groundwater.

To date, the OVP has been determined to consist of the contaminants listed in bold type in Table A-3. Constituents detected in soil samples collected from MDA L are also listed in Table A-3. Health-based action levels for many of these substances have been determined by the EPA (Appendix A of Proposed Subpart S, Part 264, 40 CFR) and are indicated in Table A-3 for reference. These action levels are based on conservative exposure estimates for both ambient air and soil. A more complete list of action levels available for substances present on the site, and for additional regulated volatile organic compounds, is included in Table A-3. Table A-3 also lists Permissible Exposure Levels (PELs) from Subpart Z Section 1910.1000 of 19 CFR

and "NIOSH Pocket Guide to Chemical Hazards" by Department of Health and Human Services (NIOSH 1985, 0709).

The action levels listed in Subpart S for noncarcinogens in soil are based on an assumed intake of 0.2 g/day for a 16 kg child for a 1-year exposure period. The action levels listed in Subpart S for listed carcinogens in soil are based on an assumed intake of 0.1 g/day for a 70 kg adult/70 year lifetime exposure period. These action levels are based upon exposure scenarios which are extremely unlikely to occur at the subject site, given the expected restrictions on future land use and public access. Although conservative, the action levels for soils listed in Subpart S will be considered guidelines for determining the success of the proposed corrective action.

In the instances where action levels for soils are not given, health risk based levels were calculated using formulas provided in Proposed Subpart S, Appendix E. These levels are also included in Table A-3. The action levels are based on either the reference dose (RfD) or the carcinogenic slope factor (CSF) as obtained from HEAST (EPA 1991, 0658).

Several of the substances identified in the soil or soil gas were not listed in proposed Subpart S, HEAST, or other public references. Because toxicity data (RfD or CSF) were not available for these substances, action levels were not determined. The concentrations of these substances in the soil and soil vapor samples from the site have generally been much lower than those of known toxic substances, such as TCA. Because these substances were found in low concentrations, and toxicity data for these substances was unavailable, they will not be used as criteria for determining clean-up objectives.

3.1 Potential Emissions

Action levels for ambient air were determined from data and formulas provided in proposed Subpart S and are included in Tables A-3 and A-4. The action levels determined for ambient air will be used as an emissions objective for potential air emissions from the selected corrective measure system.

Current emission (40 CFR, Part 61) and disposal standards (40 CFR, Part 191) for radionuclides specify that emissions or potential exposure of the public must be less than 25 millirems dose equivalent to the whole body and less than 75 millirems dose equivalent to critical organs. If additional investigations reveal the presence of radionuclides in the soil or soil vapor samples above natural background levels, then the corrective measure will be modified to prevent emission levels from exceeding the specified regulatory levels.

3.2 Clean-Up Standards

The risk-based action levels listed in Tables A-3 and A-4 will be used to assess occupational exposures and risk to off-site receptors during implementation of the corrective measure. It is expected that these action levels will also serve as a guideline for the assessment of the adequacy and completion of the corrective

action. Because the goal of the voluntary corrective action is to prevent future risk to human health and the environment, the identified action levels may not provide the sole criteria for determining an adequate extent of remediation. Because the presence of potential receptors (a 16 kg child for 5 years exposure and a 70 kg adult for 70 years exposure) on the secured chemical waste disposal area is implausible, action levels should not solely determine the adequacy or extent of the corrective measure. The true risk to distant, off-site potential receptors will be significantly less than that inferred in the action level determinations. MDA L will be held under institutional control with restricted access. The MDA and surrounding land in TA-54 are under DOE control. Eventually, the land may be transferred to Bandelier National Monument. Therefore, public access to land near MDA L for recreational use is a future land use scenario.

4.0 PRELIMINARY SCREENING OF CORRECTIVE MEASURE ALTERNATIVES

4.1 Site Characteristics

For the purposes of this screening, the site is considered to extend along the crest of the Mesita del Buey from MDA L to the northwest boundary of MDA G. Any remediation effort must conform to the particular constraints imposed by the setting of the site. These constraints include the following:

- the space restrictions imposed by the site's position along the crest of a narrow ridge and by the planned usage of the site;
- the hydrogeologic setting of the site, including lithology and permeability characteristics; and
- the characteristics of the source of the vapor plume, including its placement, its accessibility, and uncertainty regarding its precise location.

4.1.1 Space Restrictions

The site is situated along the crest of a narrow mesa; the width of which ranges from 300 to 500 ft. A portion of the site is occupied by an existing disposal site (MDA L), and the remainder will be occupied by future expansion of MDA G. This expansion will include additional disposal cells (e.g. trenches, pits, and shafts), as well as infrastructure such as roads.

Any corrective action must not interfere significantly with the current or planned utilization of the land. This would constrain the use of remediation systems or techniques which would require large amounts of surface area, or which would require substantial excavation efforts.

4.1.2 Hydrogeologic Setting

The movement of the OVP is occurring within the Bandelier Tuff, which comprises the mesa upon which the site is located. The intrinsic permeability of the tuff matrix is moderate, in the range of 10^{-8} to 10^{-9} cm^2. These moderate values suggest that vapor migration is occurring primarily through other pathways. The most probable avenue for this migration is the permeability created by joints, fractures, and horizontal laterally persistent surge bed deposits. Several of the flows underlying the site exhibit regularly spaced vertical cooling joints. In addition, high-angle fractures, probably associated with regional normal faulting, are visible in the walls of existing excavations. Other features which may be enhancing the permeability of the tuff to vapor include large elongate vesicles. These tubular features have a diameter of up to 2 ft, may be several feet in length, and have been observed within certain flows comprising the Mesita del Buey.

It is very important to define characteristics of the site geology that control migration of the OVP. If the permeability of the tuff to vapor migration is primarily due to fractures, this has several implications for any corrective action planned for the vapor plume. As with any fracture-controlled system, the degree of interconnection will control both the movement of vapor-phase organics through the tuff, and the capability of a remediation system to contain and remove them. The lateral inerconnection of joints and fractures may vary between flow units. In addition, the degree of vertical interconnection may, however, be intermittently interrupted by the presence of less fractured zones at boundaries between tuff flow units, or by differences in fracture systems between flow units.

Geologic information from boreholes at TA-54 and rock exposures along canyon walls has established the presence of laterally extensive horizontal surge bed deposits between discrete cooling units in the Bandelier Tuff. These deposits are especially present between cooling units 2a and 2b at a depth which was penetrated by the disposal shafts in MDA L. The importance of the surge beds to lateral migration of the OVP requires investigation. The actual migration pathway may be a combination of lateral movement along surge beds and lateral and vertical movement along joints and fractures.

The tuff matrix may also hinder any attempt to remove or contain the OVP. The tuff contains a large amount of poorly interconnected pore space and may have very high sorptive capacities. It is reasonable to assume that organic constituents may have been sorbed onto and into the matrix. This sorption could have occurred from the vapor phase, and possibly from the liquid phase in the vicinity of the source of the organics. Any corrective action might, therefore, have to account for both the organic vapors contained within fractures and joints, and relatively slow desorption from the matrix. From a practical standpoint, the short term implementation of a system to remove the more accessible portion of the vapor plume will probably not be sufficient, since desorption from the matrix could potentially form a subsequent vapor plume. Long term control of desorbing vapors may also be required.

4.1.3 OVP Source Characteristics

VOCs are the source of the vapor plume VOCs which were deposited in shafts and pits at MDA L. The construction of the shafts and pits renders the vapor plume source inaccessible to direct examination and removal. The shafts used for disposal were excavated directly into the tuff bedrock, and were up to 60 ft deep. These shafts are no longer used for disposal, and have been capped and sealed with concrete.

4.2 OVP Contaminant Characteristics

Available data indicates that the OVP consists predominantly of TCA, as well as TCE, carbon tetrachloride, chloroform, and tetrachlorethene PCE. Other detected constituents present at lower concentrations, or detected less consistently include toluene, xylenes, and 1,2,4-trimethylbenzene (see Section 1.2).

The primary constituents of the OVP (TCA, TCE, carbon tetrachloride, chloroform, and PCE) are similar in terms of their major physical and chemical characteristics. As indicated in Table A-3, they have relatively high vapor pressures, low solubilities in water, and relatively high Henry's Law coefficients, indicating strong partitioning behavior into the vapor phase. All have specific gravities in excess of 1 in the pure liquid phase, and relatively low viscosities. In addition, a saturated mixture of air and any of the constituents in vapor phase is considerably more dense than air alone. Dry air saturated with TCA, for example, is approximately 1.5 times more dense than dry air with no TCA (Schwille 1988, 0750).

The five constituents show relatively high persistence in the subsurface. Although biodegradation and other mechanisms of natural destruction of these compounds have been documented to occur in both natural systems and laboratory soil microcosms (Vogel et al. 1987, 0751), no information regarding these phenomena in fractured rock settings was available. Although biodegradation, both natural and enhanced, has been demonstrated for these chlorinated hydrocarbons, widespread success in destroying these compounds using bioremediation techniques has not been achieved. It is probable that natural degradation of these compounds in the subsurface of the Mesita del Buey will be relatively slow, and cannot be relied upon to control their transport and fate. In addition, biodegradation of the OVP, which contains TCE, would produce vinyl chloride as a by-product. The permissible exposure limit (PEL) for vinyl chloride is more than 100 times less than that for TCE. Hence, a substantially more toxic compound could be produced through biodegradation processes.

The physical and chemical characteristics of the OVP constituents will determine both the migration of these constituents from their source in MDA L and the effectiveness of any mechanism applied to their removal. Due to their low viscosity and high specific gravity, these constituents have been demonstrated to migrate quite readily in the liquid phase through both water-filled and air-filled fracture systems. The density of the vapor mound surrounding an evaporated liquid phase released into the subsurface would encourage downward migration of the vapor plume through the fracture system.

Vapor migration laterally and vertically through the site's unsaturated zone has occurred. The vertical extent of contamination is not known with complete certainty at the present time. Evidence of the vapor plume has been detected, however, at depths of 200 ft below the surface of the ridge crest.

4.3 Technical Limitations

Any corrective action strategy or technique selected for the reduction and control of the OVP will be controlled by the site and waste characteristics detailed in the previous two sections. These characteristics allow several major conclusions regarding contaminant transport and corrective action to be made.

- The tendency of chlorinated constituents to persist in subsurface environments for long periods without degradation indicates that some form of active remediation will be required to reduce and control the vapor plume. This is supported by the fact that the source of the vapor plume has not been clearly identified, and that this source may be continuing to release liquid and/or vapor phase chlorinated hydrocarbons into the subsurface. If this is occurring, passive measures will not effect any significant reduction or control of the vapor plume.

- The space and usage constraints of the area targeted for corrective action precludes the mass excavation of soils and bedrock targeted for remediation. In addition, most of the vapor plume is located below the maximum depth of possible excavation. *Ex situ* methods are, therefore, precluded, and only *in situ* methods will be considered.

- The same space and usage constraints preclude any remediation technique which requires either large installation areas and/or infrastructures which will interfere with disposal and disposal-related activities.

- The depth to which contamination has been detected, and the suspected high propensity for vertical migration, indicates that the *in situ* remediation used must be capable of removing vapors from depths in excess of 200 ft below the ridge crest.

- The high probability that contaminant migration is via fractures within the tuff indicates that the *in situ* remediation used must effectively access the various fracture systems to remove the vapor plume.

- The fact that the contaminants have migrated extensively in the vapor phase indicates that the *in situ* remediation must be capable of removing vapor phase constituents. Remediation methods which target water or liquid hydrocarbon removal, such as pumping, would not be useful for control of the vapor plume. If liquid constituents are present within the fractured tuff, they may exist either as a sorbed phase on and in the zeolitic inclusions, or as a residual held within fractures by capillary forces. In either case, conventional liquid pumping techniques will not be useful for remediation.

- Because these hydrocarbons are most prevalent in a vapor phase, and because the potential for these chlorinated constituents to biodegrade is relatively low, bioremediation options, whether involving the nutritive enhancement of existing microbial populations, or by inoculation with specialized microbes, would have limited effect.

In summary, the means of corrective action selected must be capable of removing vapor phase chlorinated hydrocarbons from fracture systems within tuff, at depths in excess of 200 ft below the crest of Mesita del Buey. It must require limited surface space for installation and operation, and must not excessively hinder normal disposal-related operations.

5.0 EVALUATION OF CORRECTIVE MEASURE

5.1 Theoretical Design

5.1.1 Nature of Remedy

EPA guidance (EPA 1991, 0658) indicates that vapor extraction is a feasible corrective action for a site with intrinsic permeability greater than 10^{-10} cm ^{2} with contaminants that have vapor pressure greater than 0.5 torr. Because of this guidance and the constraints delineated in the previous section, the remedy selected for corrective action is vapor extraction. Vapor extraction would be used to

- withdraw vapor phase constituents from fractures and the matrix porosity that is accessed by the extraction system;
- enhance the evaporation of constituents from the pure liquid or aqueous phase, if present, and subsequently remove them as a vapor phase; and
- control the further accumulation of chlorinated hydrocarbon vapors within the subsurface of the site.

From a process standpoint, vapor extraction mechanically withdraws vapors from soil or rock porosity, through the application of a vacuum to the targeted porosity. To apply this vacuum, a trench or well is used to provide access to the subsurface. A vacuum pump at the surface evacuates the trench or well, drawing vapors to a point of collection. After passing through the vacuum pump, the extracted vapor can be transmitted to an emission treatment system prior to release. Figure A-10 provides a conceptual view of the vapor extraction process.

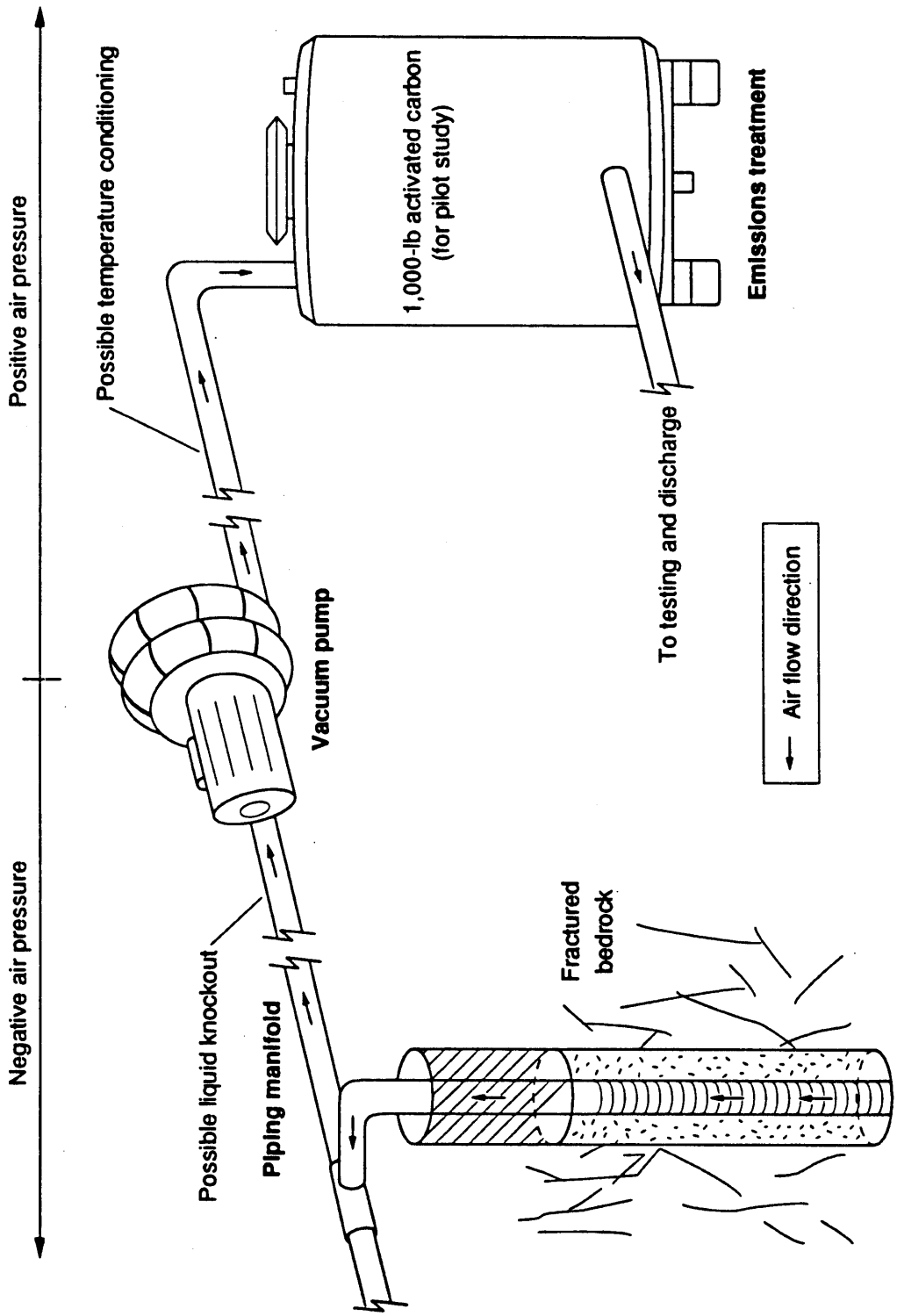

Figure A-10 Conceptual view of vapor extraction.

5.1.2 Technical Features

5.1.2.1 Preliminary Design Criteria

It is anticipated that a vapor extraction system (VES) designed for control of the OVP would incorporate the following features:

- Extraction Wells
  The point of extraction from the subsurface is typically either a well or a vacuum trench. At this site, the depth of contamination exceeds the practical depth of excavation. In addition, the operations involved in the excavation of an extensive trench system would almost certainly inhibit disposal-related operations. Wells will be utilized for providing access to the subsurface vapor plume.

  Wells utilized for vapor extraction may be vertical, angled, or horizontal. As discussed in Section 4.1, the fracture systems within which the vapor plume is presumably migrating appears to have an orientation which is predominantly vertical and near-vertical. Given this, angle and/or horizontal wells may encounter a larger number of fractures than vertical wells, with a correspondingly higher removal efficiency. However, such wells would be both more difficult and more costly to install than vertical wells.

  The following factors must be determined for well construction:

  - depth,
  - placement,
  - diameter of borehole and screen/riser,
  - screened interval and slot size,
  - orientation (vertical, angled, or horizontal),
  - riser, screen, and annular materials, and
  - wellhead construction, and connection to piping manifold.

- Piping Manifold/Knockout
  The extraction well network will be connected to the vacuum pump via a system of subgrade piping. This piping will have to be placed below grade to minimize any obstruction of site activities and traffic. Grading and sumps will be used to control the collection of moisture from condensation within this piping system. Furthermore, a knockout device will be installed on the suction side of the vacuum pump to remove entrained liquid and thereby reduce the organic load on vapor emission controls.

  The following factors must be determined during piping manifold design:

  - piping material,
  - depth of burial to preclude freezing or mechanical damage,

- type of connections,
- piping diameter required to minimize friction losses, and
- placement to minimize interference with roads, pits, etc.

- Vacuum Pump or Blower
  The vacuum pump is the central operational unit of the VES, providing the suction necessary to remove contaminant vapors and air from the subsurface, and also providing the means to transport vapors to a system for emissions control. A wide variety of vacuum pump styles are available, including regenerative blowers, centrifugal turbine blowers, liquid ring pumps, and rotary lobe pumps.

  The following factors will determine the vacuum pump selection process during system design:

  - anticipated pressure/flow requirements,
  - maintenance requirements,
  - anticipated lifespan,
  - production of side wastestreams, such as used liquid sealant,
  - capital and operating costs, and
  - compliance with existing regulations (e.g. compliance with appropriate EMA codes, noise limitations, etc.).

- Emissions Control System
  It is anticipated that some form of emissions control will be required to reduce contaminant concentrations in extracted vapor prior to discharge to the atmosphere. The treatment options include thermal oxidation, catalytic oxidation, carbon adsorption, condensation, incineration, flare, and cryogenic condensation.

  The following factors will govern the selection of emissions control during system design:

  - anticipated hydrocarbon loading rate,
  - anticipated hydrocarbon type (in this case, chlorinated species),
  - destruction or removal efficiency,
  - maintenance requirements,
  - anticipated lifespan,
  - production of side wastestreams, such as used carbon or acid-gas scrubber liquids,
  - capital and operating costs,
  - compatibility with operational environment (e.g. compliance with appropriate NEMA codes, noise limitations, etc.), and
  - compliance with existing regulations.

One conceptual configuration for such a VES is detailed in Figure A-11. This conceptual system would utilize angled wells to remove and control vapors from the area between MDA L and MDA G. Vertical wells would be utilized to remove and control vapors around and below the suspected source in MDA L. Two multistage centrifugal turbine vacuum pump stations with activated carbon emissions treatment

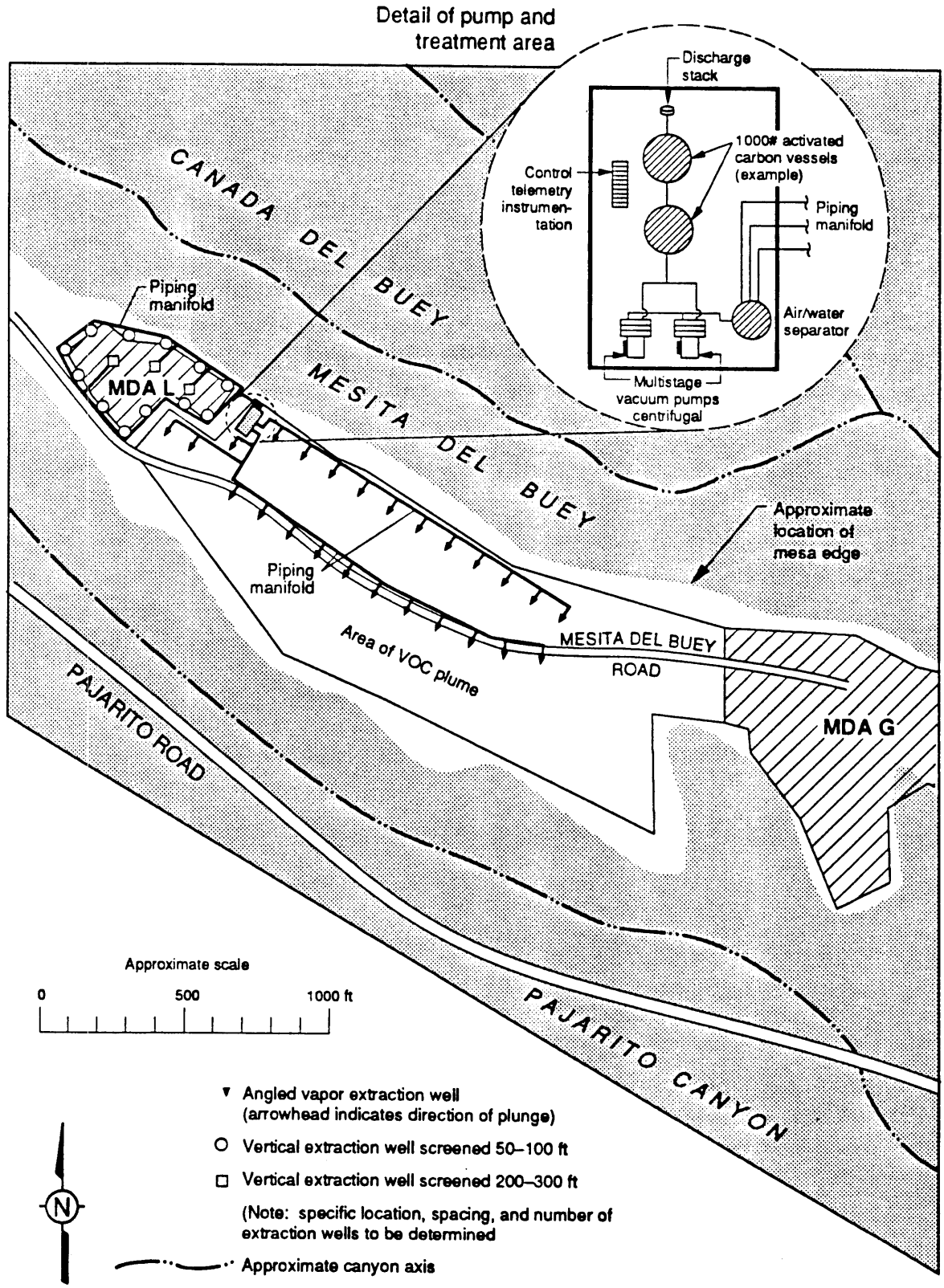

Figure A-11 Conceptual configuration of vapor extraction system.

would be utilized. Subgrade piping manifolds would follow the illustrated routes to connect each wellhead to its respective pump.

5.1.2.2 Pilot Testing

Many of the parameters governing the design of the actual VES, and the selection of the equipment components of such a system cannot be accurately predicted for large, complex natural systems at Mesita del Buey. These include, most significantly, the flow and vacuum conditions, the required density of extraction well spacing, and the hydrocarbon removal rate. To provide information regarding these design parameters, it is recommended that a pilot test be performed. The design parameters which are anticipated to be provided by the performance of a pilot test are detailed in Table A-9. The methods of measurement or testing of these parameters are also listed. See Section 8.0 for the Pilot Test Sampling and Analysis Plan.

5.1.2.3 Treatment effectiveness

The following parameters are discussed for a full scale, long term VES. The pilot test effectiveness will not be considered in this section, since it is not, in itself, a remediation technique.

5.1.2.3.1 Capacity

The required capacity of a VES will be based primarily on the following:

- the airflow needed to remove a satisfactory portion of the existing vapor plume from the targeted subsurface zone(s), and
- the airflow needed to minimize the accumulation and migration of additional vapors within the targeted subsurface zone(s).

Although the capacity of a VES can be discussed generally in terms of airflow, it must be recognized that this parameter is based upon a large number of design criteria. These include well density and construction, suction capacity, and friction losses within the piping system.

VESs may be constructed at virtually any scale, from those capable of moving only a few cubic feet per minute of air and vapors, to those capable of moving thousands or tens of thousands or cubic feet per minute. The vapor extraction capacity requirements to remediate the OVP at TA-54 cannot be readily predicted prior to the performance of a pilot test. It is anticipated, however, that a properly designed system should readily satisfy these capacity requirements, once determined.

TABLE A-9
DESIGN AND OPERATIONAL PARAMETERS PROVIDED BY PILOT TESTING

PARAMETER	PRIMARY SIGNIFICANCE	MEASUREMENT METHOD
Pressure wellhead vacuum pump suction vapor piezometer (drawdown)	Provides radius of influence data affecting extraction well spacing and placement, pressure requirements critical parameter for pump selection, means of evaluating air permeability of subsurface	Magnahelic gauge Manometer Pressure transducer
Temperature vacuum pump influent vacuum pump effluent	Affects materials selection, pump selection, adsorption behavior in activated carbon treatment	Gauge thermometer
Relative humidity of extracted vapor	Affects magnitude of condensation within the system, adsorption behavior in activated carbon treatment	Hygrometer Off-site analysis of gas samples
Air flow rate per well total	Affects pump selection, emissions control selection and sizing, emission rates, piping size	Hot wire anemometer Mechanical flowmeter Pilot tube
Response of air flow rate and vapor piezometer drawdowns to varying wellhead suctions (step test)	Affects pump selection	Combination of flow and pressure measurement methods listed above

TABLE A-9, Continued
DESIGN AND OPERATIONAL PARAMETERS PROVIDED BY PILOT TESTING

PARAMETER	PRIMARY SIGNIFICANCE	MEASUREMENT METHOD
Recovery of extraction well and piezometer pressures upon conclusion of vapor extraction (recovery test)	Alternative method of evaluation of air permeability of subsurface	Pressure measurement methods listed above
Hydrocarbon removal total hydrocarbons specific VOC concentrations	Affects emissions treatment selection, emission rates, evaluation of corrective action effectiveness	On-site analysis Off-site analysis of gas samples
Rate of water production due to condensation from extracted air	In addition to calculations based on air humidity, provides information on full-scale condensation production	Volumetric measurement of water produced
Quality of water produced	Affects immediate concern of pilot test waste disposal, also permits prediction of full-scale waste disposal/handling requirements	Off-site analysis of water
Emission treatment considerations (i.e. carbon consumption rate)	Affects selection of full-scale emissions treatment	Dependent upon emissions treatment type
Comparison of vertical versus non-vertical well performance	Affects selection of predominant well design, possibly also overall number of wells	Combination of methods listed above

5.1.2.3.2 Creation of Additional Hazards Resulting From the Implementation of the Corrective Measure

The potential for the creation of additional hazards to public health and the environment by vapor extraction is relatively low. This potential exists in the following areas:

- The emission of hazardous vapors from the system discharge
  These could occur either as fugitive emissions from connections, or from the system vapor discharge. Fugitive emissions during system operation would be possible only downstream of the vacuum pump, because the upstream piping will be maintained under negative pressure. Given that the vapor discharge will probably be placed in proximity to the vacuum pump, the extent of piping from which these leaks could occur will probably be limited and accessible. Periodic air monitoring could be utilized to supplement normal maintenance if fugitive emissions were suspected.

- The system vapor discharge would be equipped with treatment necessary to reduce concentrations of hazardous constituents below applicable regulatory or health-based standards. The effectiveness of such treatment would be periodically evaluated by sampling and analysis of vapors from both upstream and downstream of the treatment, and/or by verification of operational conditions accepted to produce a satisfactory destruction efficiency.

- The enhancement of bedrock permeability such that the potential for contaminant migration is increased rather than controlled
  This would be of concern primarily if permeability enhancements such as hydrofracturing or explosive fracturing were utilized. In order to minimize the potential for enhanced downward migration of waste constituents, it might be necessary to limit the use of these techniques to areas where waste cells were not to be located.

- Potentially contaminated soil cuttings generated during soil boring and well installation activities.

- Potential radioactive constituents
  Radioactive constituents, if present, could present significant health and safety concerns during some or all of the proposed remedial activities.

5.1.2.3.3 Ability to Achieve Corrective Action Goal

The corrective action is based primarily upon the presence and potential migration of a vapor plume. Vapor extraction is an established technique for the control and removal of subsurface organic vapors, and should therefore be capable of attaining the goal of remediation of the OVP at TA-54. The completeness of this remediation will be controlled predominantly by the effectiveness of the well installation program in intersecting the migration pathways of the vapor plume.

The corrective action program actually consists of two stages of remediation. The first will consist of retracting the OVP. The second stage will maintain passive venting for source control. Without passive source control, active extraction will have to continue for as long as required to avoid mixed waste at the expanded Area G. Pilot testing will provide subsurface flow information for OVP retraction as well as evaluating the feasibility of a passive venting mechanism for source control.

5.1.2.3.4 Waste/Site Characteristics Which May Impede Effectiveness

Some general aspects of these characteristics are discussed in Section 4.3, above. The primary characteristics of concern for vapor extraction at the OVP Site are the location, depth, and nature of interconnection of the pathways (fracture system and surge beds) within which the vapor plume is assumed to be migrating. To remediate the vapor plume, the migration pathways must be accessed by the extraction well system. Because the tuff matrix is relatively impermeable, it will be necessary for the wells to actually intersect fractures and surge beds to provide this access. Given the uncertainty regarding the fracture location and degree of interconnection and lateral variations in thickness of surge beds, it is possible that a well system could miss the interconntected pathways, and be ineffective in remediating the plume.

To reduce the possibility of this occurring, it may be necessary to

- increase extraction well density,
- modify the orientation and angle of extraction wells, and
- increase the effective radius of extraction wells.

Increasing the extraction well density or modifying the extraction well orientations through the use of horizontal or angle borings and wells would enhance the probability of intersecting more fractures. Given the predominantly vertical and near-vertical orientation suspected to be prevalent among the fractures in the tuff, borings could permit the intersection of several fractures or fracture systems and horizontal surge beds by a single well. This approach could utilize bedrock permeability enhancement fracturing techniques to create a network of new fractures in the immediate vicinity of a given extraction well. Examples of these techniques include hydrofracturing and explosive fracturing.

5.1.2.4 Useful Lifetime

5.1.2.4.1 Extraction Wells and Piping Manifold

Both well and piping materials will be selected based on, among other criteria, resistance to mechanical and chemical stress. Because they will be installed below grade, where they are protected from temperature extremes, ultraviolet exposure, and other stress, the useful lifetime of these components should be at least ten years.

Because the extraction wells will be completed within the unsaturated zone, they should be relatively unaffected by mineral and bacterial encrustation, sediment accumulations, and corrosion which shorten the useful life of many water supply and

groundwater monitoring wells. This is also anticipated to apply to the piping system, given that it will transport predominantly air, rather than liquids. The useful lifetime of the wells and piping is therefore anticipated to be in excess of ten years.

The two areas of the piping and well system anticipated to be most vulnerable to degradation and damage are the wellhead assembly and the manifold connection into the vacuum pump. It is anticipated that the wellheads will be set below grade, in protective steel or concrete boxes. Despite this, certain components, such as gauges, valves, and flowmeters, which may be included in a wellhead and manifold-vacuum pump connection, are more susceptible to deterioration than the well and piping material. Depending upon usage, these components may have a useful lifetime of 0.5 to 5 years, depending upon usage and exposure to stress.

5.1.2.4.2 Vacuum Pumps and Emissions Control

The useful lifetime of the pumps and emission control will depend largely upon selections made during the design process, and upon the usage requirements during the corrective action. The difference in useful lifetime, for example, between a carbon adsorption system and a fume incinerator may be extreme. It may reasonably be assumed, however, that any system selected would have a useful lifetime of several years with proper maintenance and upkeep of a spare parts inventory.

It may be possible to adjust the usage of the VES to maximize the lifetime of these components by minimizing their operation. After the initial stage of remediation, during which the existing vapor plume is being treated, it is anticipated that remediation will enter a control stage. This control stage would be a "maintenance level" approach, intended to remove any vapors forming in the future. Periodic operation might be sufficient to accomplish this objective. By placing the entire system on intermittent automatic operation, the lifespan of critical components could possibly be extended.

5.1.2.5 Reliability

In terms of reliability, two aspects must be considered:

- the reliability of the vapor extraction as a remedial approach, and
- the reliability of the equipment used for vapor extraction.

Both these aspects of the reliability issue may be resolved by demonstrating that the technology and the equipment are established, that is, not experimental. In addition, the technology and equipment should be utilized in a manner or for a purpose for which a history of reliable use exists.

Vapor extraction is an established technique for accomplishing the objectives of this VCAP; specifically, the *in situ* control and removal of subsurface hydrocarbon vapors. Because vapor extraction is an established technology and because it is being utilized in a conventional and straightforward manner, this remedial approach is considered reliable.

The performance of vapor extraction for most operations does not require the custom manufacture of unique vacuum pumps and emissions control. Instead, units are readily available from a number of commercial suppliers. The components required, including the various vacuum pump styles, fume incinerators, vapor-phase carbon adsorption units, etc., all have an extensive history of use in a variety of commercial applications. These components may therefore be assumed to have a satisfactory level of reliability.

5.1.2.5.1 Maintenance

Maintenance will be required periodically on most of the components of the VES. Specific maintenance concerns are identified below for each of these major components.

Wells and Wellheads

As mentioned in Section 5.1.2.4 above, the wells are not anticipated to require any significant maintenance, at least not at a frequency less than once every ten years. This low level of maintenance is anticipated because the wells are to be completed within the unsaturated zone, and thus should experience minimal encrustation, corrosion, and bacterial growth. The wellheads may require maintenance on approximately a bimonthly basis. This maintenance would include the checking of gauge conditions, and the replacement of malfunctioning gauges. It would be advisable to open and close valves during these maintenance visits to minimize the possibility of those valves freezing up during long periods of disuse.

Piping

Maintenance requirements for the piping would consist primarily of periodic checks of the condensate levels within sumps and other engineered collection points. The frequency of this maintenance would depend upon the rate of condensation generation, and would be best determined during the first several months of full-scale operation. It is reasonable to anticipate, however, that these checks could be performed on a monthly or bimonthly basis.

Above-ground piping connections, such as those at the point of connection with the vacuum pump, should also be periodically checked for damage and deterioration. In addition, checks for pressure losses which might indicate pipe leaks could be performed. Both these functions could be performed in conjunction with the bimonthly checks of the wellheads.

Vacuum Pumps

The vacuum pumps should be checked on a weekly basis at least. Specific maintenance requirements and frequency can vary considerably depending upon the type of pump utilized. Typical maintenance requirements may include

- bearing and seal replacement,
- condensate and used/excess sealant removal,
- replacement of faulty gauges and fittings,
- verification of failsafe sensors and controls, and
- electrical repairs.

Typical maintenance requirements can be satisfied by qualified technicians, pipefitter/plumbers, and technicians. More substantial maintenance, in the event of significant pump damage or failure, may require support from the unit manufacturer and/or fabricator.

Emissions Treatment

As with the vacuum pump, specific maintenance requirements for the emissions treatment system will depend upon the type of system utilized. The maintenance requirements for a multibed granular carbon adsorptive system, for example, are significantly different from those for a thermal oxidation/scrubber system. In general, however, any emissions control system utilized should be checked on a weekly basis. As with the vacuum pumps, many typical repairs could be handled without the use of specialized labor. Certain situations would require support from the unit manufacturer and/or fabricator.

5.1.2.5.2 Failure

Several events could qualify as a failure of the VES. These would include

- piping manifold rupture and wellhead damage,
- vacuum pump failure, and
- emissions treatment failure.

Two aspects of such failures must be considered. The first is the potential impact should the failure result in the cessation of VES. The second is the potential for the uncontrolled emission of hazardous constituents into the atmosphere as a direct result of the failure.

The former aspect would be of concern only if the failure was of significant duration. If the failure resulted in a system shutdown which persisted for several months, it is possible that the plume might reaccumulate from desorbing volatile constituents, and again spread through the subsurface. In this event, the potential for downward or offsite migration would recur.

The potential for extended shutdown is relatively low. Given the availability of the components utilized, even major portions of the system could be replaced within approximately six weeks in the event of a catastrophic failure. Minor damages and/or malfunctions could be repaired in much less time.

The potential emission of hazardous vapors due to component or system failure is also relatively low. Because the greatest linear extent of piping is located on the negative pressure portion of the vacuum pump, losses of integrity due to breakage will result in the flow of air into the system, rather than losses out to the environment.

The piping under positive pressure, that between the pump and the emissions treatment, would probably be of much shorter linear extent, more protected from potential damage, and monitored more closely. For additional protection, a pressure sensor/switch failsafe could be used to shut down the VES in the event of loss of backpressure due to line failure on the positive pressure side of the pump.

The failure of the vacuum pump would not result in any releases to the atmosphere because vapor flow would cease upon pump failure. The failure of the emissions treatment, however, could result in such releases. This failure could result from loss of ignition in a thermal or catalytic oxidation system, or from carbon breakthrough in an activated carbon adsorption system. Appropriate failsafe sensor/switch arrangements should be utilized to minimize the possibility of these occurrences; examples would be a hydrocarbon vapor sensor on the discharge of the carbon sensor to detect breakthrough, and a heat sensor (e.g. a "fire eye") to monitor for flameout of the oxidation system.

5.1.2.5.3 Implementability

A VES, because it utilizes nonspecialized components and common installation techniques, should be readily implementable to remediate the OVP at TA-54. Specific issues are addressed below.

5.1.2.5.4 Construction

Construction of the infrastructure for the vacuum pump and emissions treatment should be straightforward. A concrete foundation for each major component, or a single larger foundation for all major components, would be required. Utilities, including single- and three-phase electricity, and possibly water and natural gas, would have to be supplied. An enclosure for the vacuum pump and treatment system might also be required. All construction would have to be compatible with the requirements of the setting, such as noise, ventilation, and fire hazard rating.

The construction of the piping system would utilize standard trenching, piping, and backfilling methods. Even if more sophisticated measures, such as double-walled piping or rock trenching, were required by the final design, these should not significantly decrease the implementability of the piping. These measures, while more specialized, are still readily available from a large number of commercial suppliers and/or contractors.

If vertical wells are utilized, drilling contractors capable of performing the construction of these wells are numerous. Angled or horizontal wells will require drilling contractors with specialized equipment and expertise. The location and mobilization of these contractors could potentially delay the construction of these wells. For this reason, suitable contractors should be located and the groundwork for their use established well in advance of the projects with an anticipated need for their services. This might be pursued, for example, concurrently with the pilot test.

5.1.2.5.4.1 Site Conditions

Site conditions which could impair the ready implementation of a VES include the following:

- areal restrictions due to the narrow width of the crest of the Mesita del Buey,
- uncertainty regarding the specific placement of future waste cells, such that vapor extraction piping, wells, etc. might interfere with waste cell construction, and
- the onset of winter conditions at the site, which would render field efforts more difficult.

With regard to the initial two conditions, both of which reflect space limitations, the VES would require only a very small fraction of the ridge crest area. Should future waste cell construction require the destruction, rerouting, or relocation of particular components, this could be accomplished with only short term disruption of the vapor extraction activities.

While winter conditions would impair either a pilot test or full-scale installation, these operations could still be completed during winter, if necessary. Scheduling, materials handling, health and safety, and vehicular/equipment selection would simply have to be adjusted to reflect the additional stress of winter conditions.

5.1.2.5.4.2 Permits

Remedial activities at active treatment, storage and disposal facilities require modification of the facility's RCRA Part B permit. The VES at the OVP site will require Class III permit modification approval from NMED or EPA prior to implementation (40 CFR, Section 270.42).

In addition, the VES may require an air quality permit from NMED. Air quality permits are required when concentrations of toxic volatile compounds exceed given threshold values at a point prior to emission treatment and control according to the New Mexico Air Quality Standards and Regulations, Section 702, Parts One and Two. Depending on the anticipated concentrations of volatile organic compounds in the extract, both the pilot test and full-scale VES may possibly require an air quality permit.

Construction permits will also be required for the construction of the pilot test and full-scale VES. Application and approval processes for the necessary permits may affect the proposed implementation schedule.

5.1.2.5.4.3 Equipment Availability

The major components required for both pilot testing and full scale implementation are anticipated to require less than six to eight weeks for acquisition. Shorter periods may be possible, particularly if rental units can be identified for pilot testing.

5.1.2.5.4.4 Offsite TSD

Hazardous waste that may result from the selected emissions treatment system will be disposed of by the Laboratory at permitted facilities in a proper manner. Standard Laboratory health and safety precautions regarding the classification, transport, storage and disposal of hazardous wastes will be observed.

5.1.2.5.5 Timeline

Implementation of a VES could be initiated at any time. The incremental steps in which the implementation would occur are as follows:

- pilot test planning and design (including permitting),
- pilot test equipment acquisition and system installation,
- pilot test performance,
- data evaluation,
- full scale planning and design (including permitting),
- full scale equipment acquisition and system installation, and
- full scale startup.

5.1.2.5.5.1 Initial Implementation of Full Scale Operations

Although an exact schedule cannot be established until more detailed planning of the implementation increments listed above has been performed, it is anticipated that pilot test preparation and performance will require three to four months; data evaluation and full scale design will require approximately two to three months; and installation of the full scale system will require four to six months. Full scale operations could begin within nine to 13 months of project commencement.

5.1.2.5.5.2 Beneficial Results

Because of the nature of the OVP and the corrective action, beneficial results will occur immediately upon the initiation of full scale operation of the VES. To be more specific, the primary problem targeted by this corrective action is the presence of an accumulation of organic vapors within the subsurface. The withdrawal of these vapors during vapor extraction will begin to mitigate this problem immediately. If there were no additional contributions to the vapor plume, it would theoretically require only the removal of one complete pore volume to remove the entire vapor plume. In reality, additional vapors will enter the fracture system from desorption from the rock matrix, evaporation of the potential residual liquid phase, and

continued release from the pit, impoundments, and shafts at MDA L. In addition, a portion of the vapor plume will be poorly accessible to vapor extraction, because of its location in dead end fractures, very fine fractures, or fractures which are not effectively accessed by the VES.

5.1.2.6 Safety

Implementation and operation of a VES to remediate the OVP in TA-54 will involve health and safety considerations during both the construction and operation phases of vapor extraction. Construction- and installation-related hazards which are primarily physical in nature are not unique to this corrective action, and require no detailed explanation within this VCAP. This is also true with regard to potential exposures to vapor contaminants during drilling and trenching, because no extreme level of personnel hazard is anticipated. These potential hazards can be readily handled by the preparation and observance of an adequate health and safety plan for construction operations.

This VCAP focuses on safety considerations which are uniquely applicable to a large-scale vapor extraction project. As mentioned previously, the primary constituents of the vapor plume are TCA, TCE, and PCE. Radioactive gases may also be present. These constituents will be used to outline general safety concerns and procedures for implementation and operation.

5.1.2.7 Fire

Of the three primary constituents, TCA and TCE are flammable, with a flammable range from 7 to 16% in air. Certain secondary vapor plume constituents, such as toluene, are also flammable. When vapor extraction is performed from areas at or near the vapor source, the potential exists for the collection of flammable vapor/air mixtures.

Given this potential, the system would be constructed to

- isolate potential sources of ignition from internal (vapor transport) portions of the system components, and
- minimize the potential for extensive propagation of an ignition front along the system piping, or between major components.

Because of the construction of the VES, potentially flammable vapors would be isolated within piping for the greater portion of the system. Potential ignition could occur, however, during maintenance, or from losses in piping integrity. All work in the vicinity of the system should, therefore, assume the presence of a flammable atmosphere until it is established otherwise. Further minimization of ignition potential would be achieved through the use of intrinsically safe components whenever possible.

The potential for flame front propagation could be minimized by the periodic placement of flame arrestors at strategic points along the vapor transport path. Critical placements would be on either side of the vacuum pump. Periodic placement along the piping manifold would also be required.

The emission of potentially flammable vapors from the discharge of the VES would, under normal operating conditions, be controlled by the emissions treatment system. Control under emissions treatment system failure is discussed in Section 5.1.2.5.2.

5.1.2.8 Explosion

Explosive hazards during vapor extraction operations are related to the accumulation of flammable vapors within confined spaces. These issues are discussed in the preceding subsection.

5.1.2.9 Worker Exposure

As discussed in Section 5.1.2.6, physical hazards and chemical exposure hazards which are typically encountered during hazardous waste site remediations will not be discussed in this VCAP. These issues are relatively straightforward and typical, and will be delineated within the health and safety plans prepared for each field operation. This VCAP will focus on worker exposure issues which would apply specifically to the operation of a vapor extraction remediation at the OVP site.

Under normal operations, the potential for worker exposure to vapor-phase contaminants is relatively low. Vapor contaminants are transported within the confines of a pipeline throughout the system to the point of ultimate discharge following emissions treatment. Exposure to these contaminants could only result from access to the closed system due to maintenance activities or piping failure, or due to emissions treatment failure. The potential impact of failure of emissions treatment and piping is discussed in Section 5.1.2.5.2, with recommended design features to minimize the impacts of such failure.

Access during maintenance would require careful management to control the potential for exposure to vapor. This would include the establishment of vapor testing procedures, possibly using chemical vapor testing tubes, and/or radioactivity sensing upon initiation of access. Should concentrations exceed specified health-based limitations for targeted compounds, the level of personal protection required would be appropriately upgraded. These exposure management procedures would be delineated in the health and safety plan for VES operation.

Potential exposure to aqueous-phase contaminants will also be present during the testing, removal, and handling of any condensate waters accumulated in the pipeline sumps and vacuum pump air/water separators. As a result, hazardous liquid handling procedures would also have to be delineated in the operation's health and safety plan.

5.1.2.10 Community Exposure

The potential for community exposure related to the operation of a VES at the OVP site will be very low. Public access to the site is heavily controlled, so that access by the general public to the system or its proximity should not occur. In addition, due to the relative isolation of the site, contaminant releases would have to travel significant distances before affecting a residential area.

The potential for such exposure has been identified in the event of either of two occurrences. The first is the failure of condensate liquid collection components, such as pipeline sumps and vacuum pump air/water separators. The failure of such a component could release potentially contaminated waters, which could possibly proceed by surface drainage into Canada del Buey or Pajarito Canyon. This possibility could be mitigated by the utilization of engineered controls, such as secondary containment, or the placement of condensate collection components so that their failure would not readily commingle with surface drainage off the flanks of the Mesita.

The second possibility for community exposure would result from the failure of the emissions treatment system, which would result in the discharge of extracted soil vapor into the atmosphere. This possibility, and engineered controls which would be required to minimize it, is discussed from the perspective of system failures in Section 5.1.2.5.2, above. In summary, failsafes and interlocks would be required to terminate system operation, and therefore terminate vapor discharge, in the event of emissions treatment failure.

5.2 Environmental Assessment of Corrective Action

5.2.1 Beneficial and Adverse Effects

Beneficial Effects

The fundamental beneficial effect of the application of a VES to remediate the OVP at TA-54, assuming the system functions as anticipated, is the reduction of the mass of hydrocarbons within the plume, and the implementation of controls on the further migration of plume contaminants. This effect is anticipated to commence immediately upon initiation of vapor extraction, and to persist as long as hydrocarbon withdrawal continues. All other benefits of the corrective action will result, either directly or indirectly, from this effect. These benefits include

- minimization of the risk of impact to groundwater by downward migrating vapor-phase volatile organics,
- minimization of the risk of worker and public contact to the vapor plume, and
- control and possible treatment of the vapor plume source.

Adverse Effects
No significant adverse effects are anticipated for the successful application of a properly functional system.

5.2.2 Environmentally Sensitive Areas

No areas of unusual environmental sensitivity have been identified.

5.2.3 Mitigation of Adverse Impacts

The mitigation of adverse effects through the use of engineered and procedural controls is discussed in Section 5.1.2.6.

5.2.4 Source Control

The term "source" may be applied in two contexts to the OVP. The first context would be in referring to the source of the vapor plume, which is believed to be liquid chlorinated solvents disposed of at MDA L. The second context would be in referring to the downwardly migrating component of the vapor plume itself as a potential source of groundwater contamination.

Provided that the extraction well installation process provides adequate access to the waste solvents producing the vapor plume, some degree of removal of these solvents should occur. This removal would result primarily from the evaporation of volatile constituents into the air flow moving through the fracture permeability. The degree of removal cannot accurately be quantified at the current level of understanding regarding the site.

With regard to the second context of "source," the VES should reduce the capability of the vapor plume to migrate downward towards groundwater under gravity-driven or natural pressure gradient-driven flow. The reduction of this capability would also be a form of source control.

The capability of the vapor plume to move downward would be reduced by two mechanisms. The first is the reduction of vapor concentrations which would have a corresponding effect on vapor density. The density loss would reduce the potential for downward vapor migration. The second mechanism would be through simple capture of downwardly migrating portions of the vapor plume by the placement of extraction wells below the lower margin of the plume. Migration due to natural pressure gradients would be restricted by the imposition of a larger artificial pressure gradient on the fracture system.

6.0 COST ESTIMATE

The estimated cost of implementing this VCAP is shown in Table A-10. These estimates are based upon the following assumptions:

- Wells are on 100 ft spacing.
- The drilling cost is $125/ft.
- Each well will be drilled at a 30 degree angle requiring deviations surveys.
- Drill depth is 380 linear feet.
- Wells drilled using open hole technique will be at a rate of 50 ft per day.
- Wells drilled using drill and drive casing technique will be at a rate of 25 ft per day.
- VOC analysis will be CLP with data validation (assume $700/sample and 1/50 ft).
- Field GC include operator and GC and equipment and field lab (assume $200/h).
- Field crew rate is estimated to be $365/h with 10/day.
- Field crew includes Field Team Leader, Site Geologist, Sample Coordinator, Radiation Protection Technician, Site Safety Officer, and Data Manager.
- Management rate is assumed to be $300/h.
- Management includes OUPL and the Assistant.
- Other Direct Costs (ODC) is estimated at $20/h.
- Pipelines cost $50/ft installed.
- Pump stations cost $40,000 each, installed.
- Treatment system costs $160,000, installed.
- System operators (2) rate is assumed to be $90.

Because of the complex geologic properties of the area, it will be necessary to perform a pilot test to determine the host rock physical and chemical parameters needed for the design of the proposed VES. The pilot test will also provide information regarding the character and extent of the OVP.

TABLE A-10
VCAP COST ESTIMATES

ACTIVITY	TOTAL COST (Dollars)
Labor Subtotal:	$337,500
Drilling Subcontractor:	$142,500
Analytical Subcontractor	$ 18,200
Borehole Geophysics Subcontractor:	$ 21,980
Packer Subcontractor:	$ 92,720
ODC's:	$ 1,200
Total Estimate:	$614,100

The information gathered from the sampling and monitoring activities outlined in Section 5.3 of this RFI work plan will be used to develop a model of the vertical extent of the OVP. The information gathered from the pilot test will be used to develop and refine the conceptual model of the VES.

Using the developed models of the OVP and VES, a detailed VES design will be prepared. The VES design will consist of construction and procurement specifications, and will include a piping and instrumentation diagram; a pilot plan; piping isometrics; an equipment list; and piping, instrumentation and electrical schedules. In addition, the VES design will include a description of the design basis, operating conditions, and applicable regulations and standards.

Implementation of the corrective measure can be broken down into four basic activities: construction, testing, training, and operation. The scope of each of these activities will be determined by the VES design. Until the necessary preliminary activities are complete, it is not feasible to develop a complete cost estimate for implementation of the VES.

7.0 SCHEDULE FOR IMPLEMENTATION

The schedule for implementation of the VES will depend upon the final detailed design of the VES. The design of the VES, in turn, is dependent upon additional site investigations, including the results of the pilot test, and the resultant model of the OVP. A tentative schedule of completion of various activities leading up to detailed design of the VES is provided in Table A-11.

It is anticipated that the SAP, QAPP, HSP, and RMP will be prepared simultaneously. Upon completion of these plans, activities requiring field and analytical services will commence. Sampling and analysis of existing wells; installation, sampling and analysis of deep wells; and passive air monitoring will occur during the same time interval. Following evaluation of the data obtained from these activities, the pilot test will commence. The development of models of the vertical extent of the OVP and of the VES will occur in conjunction with the field and analytical activities. As results are obtained from the pilot test and analytical results are received, they will be used to update and refine the developing models.

The detailed design of the VES will be completed subsequent to the final revisions of the OVP and VES models. Once the VES design is completed, implementation of the VES will begin. Implementation of the VES will occur in four stages: construction, testing, training, and operation.

TABLE A-11
SCHEDULE FOR IMPLEMENTATION OF VCAP

ACTIVITY	SCHEDULED DATE FOR COMPLETION
Sampling and Analysis Plan for MDA L and MDA G	May 18, 1992
Quality Assurance Project Plan	May 18, 1992
Health and Safety Plan	May 18, 1992
Records Management Plan	May 18, 1992
Sampling and Analysis of Existing Wells	On-going Quarterly
Passive Air Monitoring	See Annex I
Installation, Sampling, and Analysis of Deep Wells	See Annex I
Surge Bed Characterization (Critical Path)	See Annex I
Pilot Test	
Planning and Design	To be determined
Construction	To be determined
Operation	To be determined
Data Evaluation	To be determined
Report of Vapor Plume Vertical Extent	To be determined
Model of Vapor Extraction System (VES)	To be determined
Detailed Design of VES	To be determined
Construction of VES	To be determined
Testing of VES	To be determined
Training	To be determined
Operation of VES	To be determined

8.0 INTRODUCTION

In order to develop operational parameters for a full-scale remediation system to address an organic vapor plume (OVP) at MDA L, a vapor extraction pilot test will be performed. The OVP consists primarily of TCA, chloroform, TCE, and PCE, with lesser amounts of other organic compounds. It is suspected to be migrating downward and outward from the disposal units at MDA L, through fractures, surge beds, and possibly matrix porosity of the Bandelier Tuff. This VCAP recommends vapor extraction as the remedy selected for corrective action addressing this OVP.

8.1 Overall Rationale for Pilot Test

A pilot test of vapor extraction would confirm the effectiveness of this approach for the remediation of the OVP, and would provide data to support the full-scale implementation. Table A-12 presents the summary of parameters for the VCAP pilot study.

8.1.1 Operational Parameters for Full Scale Implementation

The primary goal of the vapor extraction pilot test will be to obtain data necessary for planning and implementing a full scale VES. The design and operational parameters for a system capable of remediating most or all of the OVP would be derived by extrapolating and modifying the pilot test data to the appropriate scale of operation. This effort would be supplemented by a modeling approach, in which pilot test data would be used to model the flow, transport, and mass transfer of OVP contaminants under various vapor extraction conditions. This modeling would then be used as a design aid to identify optimal operational conditions and anticipate cleanup periods.

The basic parameters which would be measured during the pilot test would include

- vapor flow rates from each of the extraction points;
- the radius of influence for each extraction point (vacuum versus time and distance);
- evaluating diffusion time constant by intermittent cessation of pumping while monitoring pore gas and extracted concentrations;
- operational vacuums for the vapor extraction system;
- removal rates for VOCs;
- the presence and level of radioactive constituents;
- the rate of water (condensate) production during the extraction, and the quality of that water; and

TABLE A-12
SUMMARY OF PARAMETERS FOR VCAP PILOT STUDY

Activity	Sampling and Analysis Parameters
Objective	Drill and complete 3 wells to be used in a pilot study to collect data for the VCA design
Prioritized Data Uses	Voluntary corrective action design Site characterization Risk Assessment
Appropriate Analytical Levels (I-V)	Voluntary Corrective Action Design III (EPA 1987, 0086) Site Characterization III Risk Assessment III
Contaminants of Concern	SW 846 VOCs
Level of Concern	IWP - Appendix C
Required Detection Limit	SW-846 Required Detection Limit Level III
Critical Samples	All samples collected from three boreholes
Level I Field Screen	PID/FID Field Screen
Level II Field Screen	GC PID/FID
Level III	SW-846
Staff Requirements	Field Team Leader Geologist Core Material Team Member Data Team Member Health and Safety Specialist Drill Crew
Data Types	CLP-Like Data Packages
Sample Type	Grab: Air TO-14 Method or resin tubes
Number of Samples	3 wells x 4 intervals = 12 samples
QA Samples	Trip Blank (daily) Equipment Rinsate (daily) Duplicate (1)
Background Samples	Ambient air near wells LLC-86-22, LLC-86-24
Sampling Procedures	Evacuate tubing above the packer with calibrated pump Sample using TO-14 Technique or resin tubes

- passive air flow entering/exiting boreholes and existing wells.

In addition, the degree of interdependence between certain of these parameters would be measured. This would include the relationships between operational pressure and flow rate, between flow rate and radius of influence, and between flow rate and VOC removal and character. Also, if diffusion limitations to the pilot test are encountered, oscillatory flow might be considered as an alternative method for evaluation and pilot testing.

8.1.2 Performance Comparison Between Vertical and Non-Vertical Extraction Wells

In addition to the parameters detailed in the previous section, one purpose of the pilot test will be to evaluate the performance of vertical versus nonvertical (angled and/or horizontal) extraction wells. The fracture systems within which the vapor plume is suspected to be migrating have a predominantly vertical or near-vertical orientation. Given this, angled or horizontal wells should encounter a larger number of fractures than vertical wells, and would provide for better coverage of the plume with fewer wells. However, nonvertical wells would be both more difficult and more costly to install than vertical wells.

In order to determine whether nonvertical well performance is substantially better than that of vertical wells, both types of wells will be installed within comparable depth intervals, and their performances compared directly. Performance will be evaluated in terms of flow rate, wellhead vacuum required, VOC concentration, VOC mass removal, and other parameters. Because highly specialized equipment is required for the installation of horizontal wells, angled wells will be used for the nonvertical portion of the comparison.

8.2 Pilot Test System Design and Installation

The vapor extraction system will consist of several components or subsystems, each to perform a portion of the extraction/treatment/discharge sequence. The extraction system will be based on a network of extraction wells (vertical and nonvertical), which will be connected via a manifold system to the suction (vacuum) side of a blower system. The vacuum exerted by the blower will be transmitted to the subsurface via the manifold system and extraction wells. Organic vapors and air flowing from the subsurface in response to this vacuum will pass along the manifold, through the blower, and to the emissions treatment system. After the treatment of the airstream, the effluent will be released to the atmosphere.

The specific components of the system to be used for the vapor extraction pilot test will include

- six vapor extraction wells, four of which are vertical and two of which are angled;

- nine vapor piezometers, each with probes set at six depths, to permit assessment of the effect of the extraction system at critical areas;
- a manifold and piping system to connect the extraction wells into the blower;
- a blower system which will include the blower, an air/water separator, and ancillary instrumentation;
- an emissions treatment system consisting of vapor-phase granular activated carbon;
- an emissions discharge system to exhaust the effluent stream to the atmosphere; and
- a data acquisition system to measure and record critical system operational parameters.

8.2.1. Phase Approach to Pilot Test Implementation

The first phase will be to install the four new vapor monitoring wells. The wells will further define the vertical extent of the OVP and confirm whether the surge bed is acting as a preferred pathway for contaminant transport. If the OVP is shallow, then the deep extraction well can be omitted or modified for depth.

The second phase will be to install the easternmost set of extraction wells and vapor piezometers and hook up to the blower and treatment system. The pilot test on this first set of extraction wells will allow for evaluation of initial lateral spacing for extraction wells and vapor piezometers. Evaluating the initial well spacing will allow spacing on the second set to be optimized for the most appropriate data collection.

The second set of extraction wells and vapor piezometers will be the westernmost set. This location will be refined by evaluating the performance of the first pilot test. With site specific knowledge of the radius of influence for extraction wells, the second set of wells can be placed in order to avoid an air pathway connection to disposal shafts in MDA L.

If the quality of data obtained from the first set is not suitable, the second well set can be placed where needed. Finally the angled set of extraction wells and vapor piezometers will be installed to evaluate the performance of angled versus vertical extraction wells.

8.2.2 Subsurface Penetrations

For the pilot test, three types of subsurface penetrations will be performed: monitoring wells, extraction wells, and vapor piezometers. The proposed locations of the new monitoring wells are shown in Figure A-4. The proposed locations for the extraction wells and vapor piezometers are shown in Figure A-12.

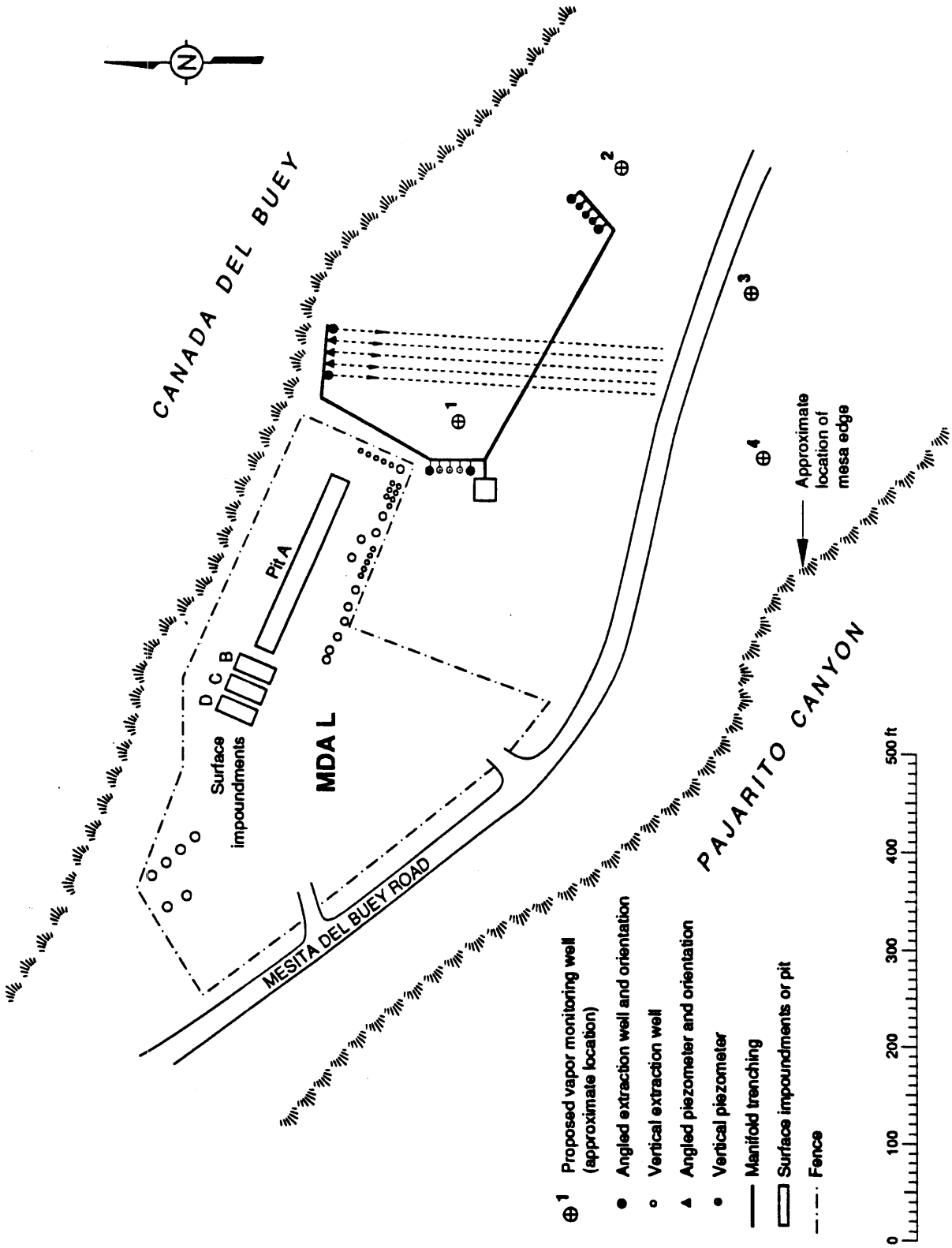

Figure A-12 Locations for extraction wells and piezometers with trench and blower/treatment system. (Base map modified from IT Corp. 1987 and 1991.)

8.2.2.1 Monitoring Wells

Four new vapor monitoring wells are proposed as shown in Figure A-12. One will be drilled between existing monitoring wells 2, 24, and 25 to further define the vertical extent of the organic vapor plume. Three additional wells will be drilled near the edge of the plume to determine the effect of the pyroclastic surge bed in transporting VOCs away from the source.

All new monitoring wells will be drilled to a depth of 10 ft below the surge bed or until no VOCs are detected. Following the VCAP pilot study, these wells may be used as part of the VES and might serve as an additional barrier to organic vapor movement into MDA G.

8.2.2.2 Extraction Wells

Four vertical extraction wells will be installed for the pilot test. One pair will be placed in an area which previous studies (IT Corporation 1987, 0327) have shown to have high organic vapor concentrations; the second pair will go into a low concentration area.

For each pair, one well will be installed with a screened interval of 50 to 200 ft below grade. The second well will be screened from 200 to 300 ft below grade. The use of staggered screened intervals will allow for evaluation of the vertical distribution of the vapor plume in the specific areas selected for drilling. It will also provide information on vertical variations in air permeability and other flow parameters. Specific installation and construction details for vertical and nonvertical wells will be outlined in Section 8.2.1.4.

Two additional extraction wells will be installed at an angle of approximately 30° from the vertical. Once again, one well will be screened at an interval of 200-300 ft below grade; the other will be screened at an interval of 50-200 ft below grade.

At this angle and with a target total depth of 300 ft below grade, the borehole for the deeper angled extraction well would span the entire width of Mesita del Buey and terminate at a length of approximately 345 ft from surface measured along the axis of the boring. The shallower angled extraction well, which would have a total vertical depth of 230 ft, would have a length of approximately 280 ft from surface measured along the axis of the boring.

A typical wellhead configuration for the extraction wells to be used in the pilot test is illustrated in Figure A-13. Each wellhead will be equipped with a magnahelic vacuum gauge (range 0 to 150 in. of water vacuum) or suitable pressure transducer.

8.2.2.3 Vapor Piezometers

Three vapor piezometers will be installed in conjunction with each pair (vertical and nonvertical) of vapor extraction wells, for a total of nine piezometers. They will be used to measure the effect of vapor extraction at a range of distances from each

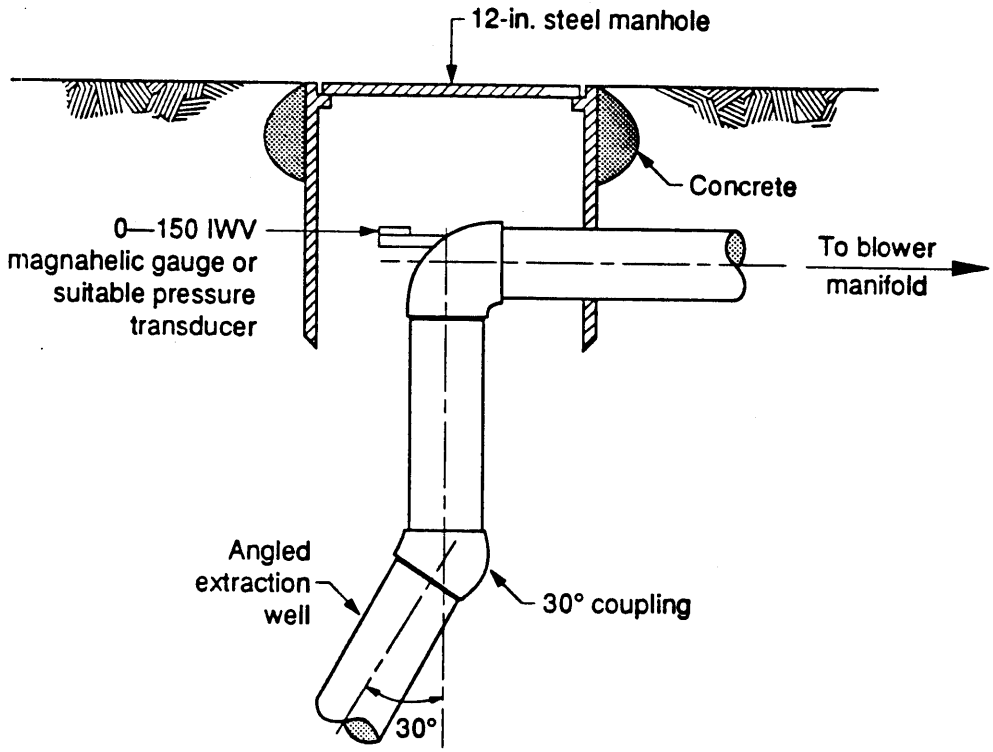

Figure A-13 Extraction wellhead construction (not to scale).

extraction well and a range of depths adjacent to each well. The placement of piezometers at a range of distances will permit the determination of a radius of influence, as well as providing distance-drawdown data for the modeling effort. The placement of piezometers at a range of depths will permit the evaluation of variations in the flow characteristics of different portions of the Bandelier Tuff. The installation details for vapor piezometers are provided in Section 8.2.1.4.

Each vapor piezometer will contain six monitor probes set at different depths within a single borehole and isolated by annular seals. A schematic diagram of the construction for those piezometers associated with the vertical extraction wells is shown on Figure A-14A. A schematic diagram for vapor monitoring probe construction is shown on Figure A-14B. For the vertical vapor monitoring probes associated with the extraction wells screened from 50 to 200 ft, probes will be placed at 75, 125, and 175 ft below grade. For the extraction wells screened from 200 to 300 ft, the probes will be placed at 225, 250, and 275 ft below grade. Each set of three piezometers will be installed at distances of 10, 25, and 40 ft from the extraction well (Figure A-12). If site conditions permit, these three piezometers will be placed in a linear array radial to the extraction well. The second and third sets of vapor piezometers will be installed at lateral distances as adjusted in the field by observation of tuff characteristics and the performance of the first pump test.

A similar placement pattern will be utilized for the piezometers associated with the two angled extraction wells. The six monitor probes within each of these piezometers will be placed within an angled borehole, which will parallel the trend and plunge of the angled extraction wells. As with the piezometers associated with the vertical wells, the probes will be placed at depths of 75, 125, and 175 ft below grade (vertical depth) for the shallower well, and at 225, 250, and 275 ft below grade (vertical depth) for the deeper well.

8.2.2.4 Drilling, Sampling, and Installation Methods

All extraction well and piezometer installation will be performed using air rotary methods. The depth requirements and consolidated nature of the material suggest that auger drilling methods would have difficulty in completing the drilling program. Mud rotary would be feasible, but might result in permeability losses associated with the plugging of fractures by drilling fluids. By using air rotary methods, formation damage and liquid losses would be minimized, which will maximize the efficiency of the well and minimize or eliminate development time.

During the use of air rotary drilling methods, the presence of VOCs, dust, and/or radioactive vapors will require the implementation of an emissions control system for the air outflow from the borehole. Appropriate monitoring will be performed during the drilling process to evaluate the necessity for such control measures, based on both health and safety considerations and on air emissions limitations, if applicable. Possible control mechanisms include a cyclone separator to remove dust and drill cuttings, a particulate filter to remove dust too fine for the cyclone to affect, and carbon adsorption for the removal of VOCs.

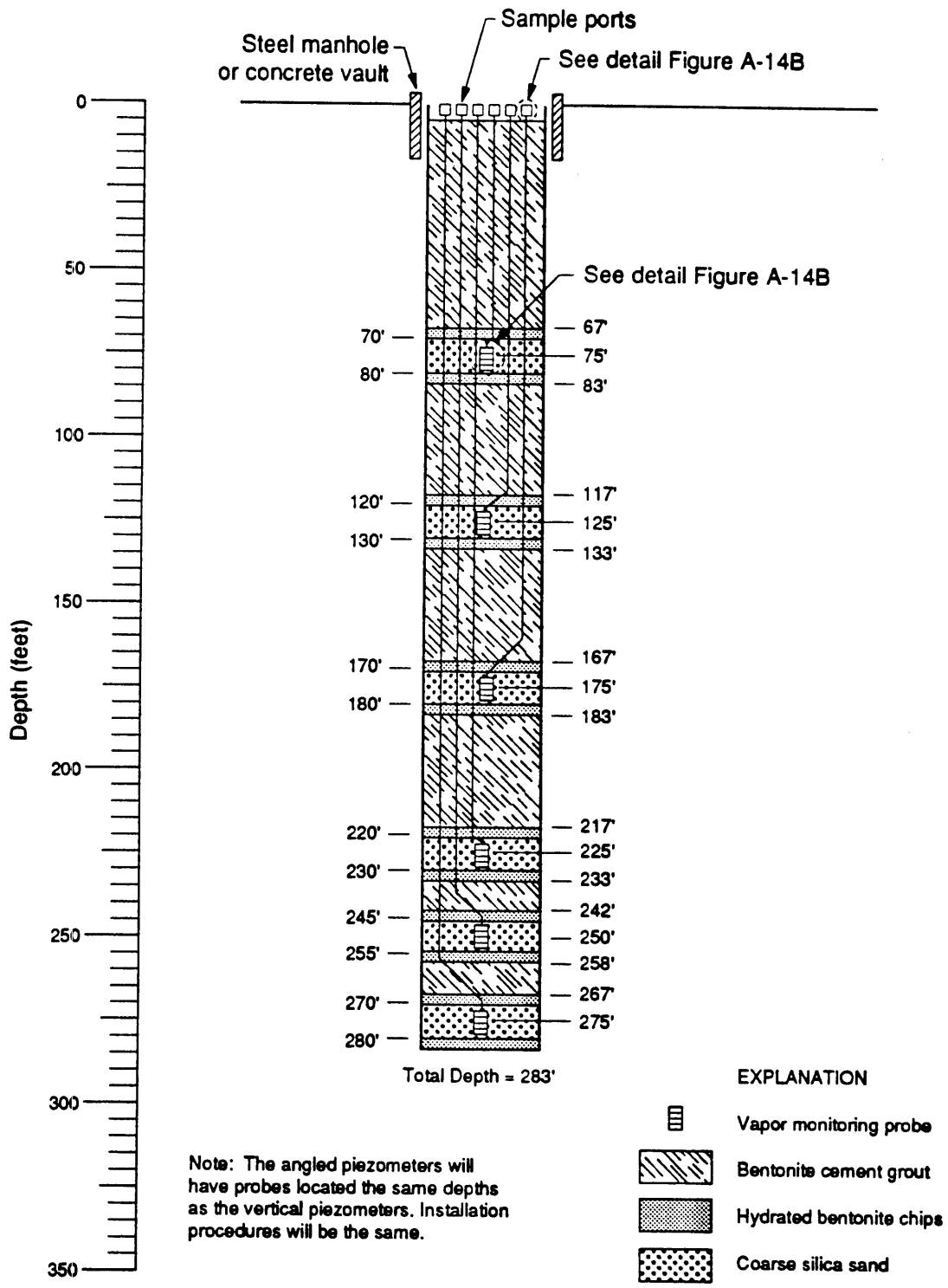

Figure A-14A Vapor piezometer construction.

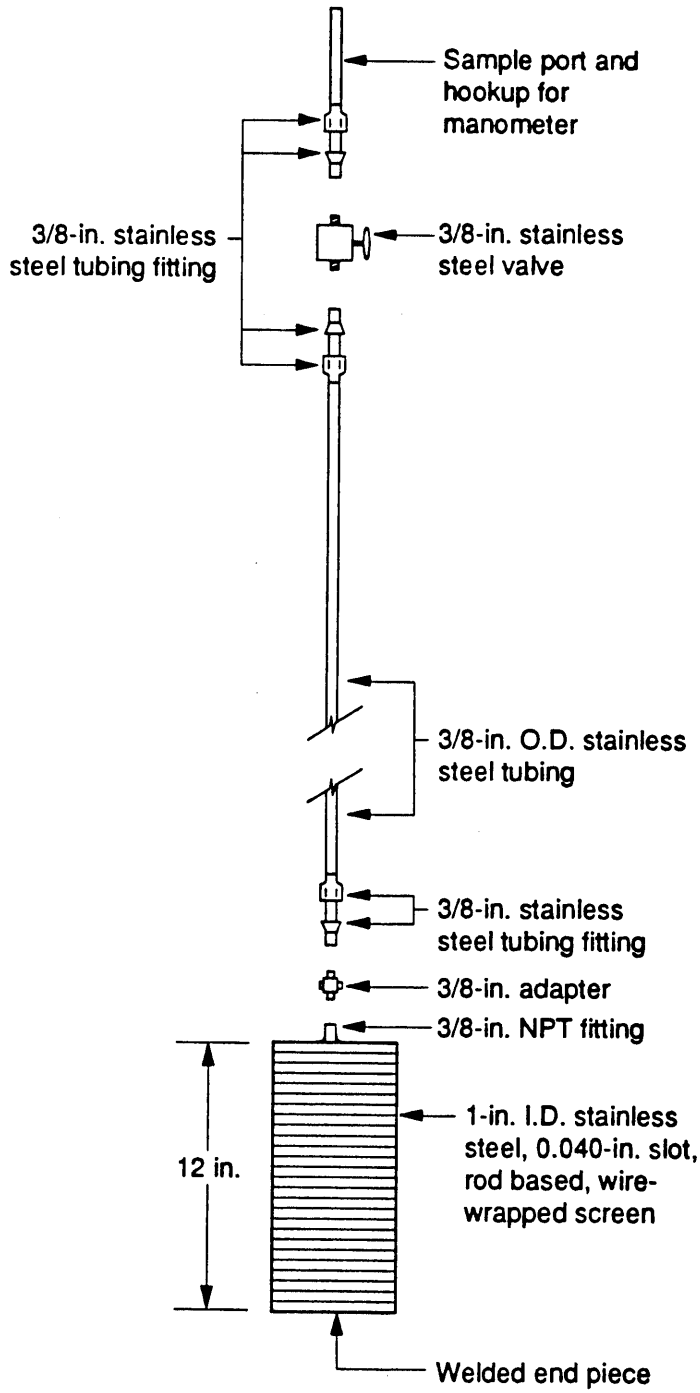

Figure A-14B Vapor monitoring probe construction (not to scale).

Drilling Procedures

All subsurface penetrations will be advanced in two stages. A 4-3/4 in. pilot hole will be drilled initially; all sampling will be performed during this phase of drilling. Following termination of this pilot hole at the desired total depth, the borehole will be reamed to a nominal diameter of 8 in. for extraction well installation or to 10 in. for piezometer installation.

Sampling will be performed using air rotary rock coring methods. The boreholes will be continuously cored from the top of the tuff to the total depth of the borehole.

An on-site geologist will use these core samples, as well as drill cuttings, drilling rate, and other parameters to prepare a detailed boring log for each penetration. Core samples will be evaluated for correlation with similar depth cores from other boreholes in the vicinity, as well as for other typical core description parameters. All core samples collected will be labeled, boxed, and retained at the site for further testing. Each box will be labeled with the well or piezometer designation and other relevant information.

Well and Piezometer Installation

Upon termination of the reamed borehole, the extraction well or piezometer will be installed into the borehole. Different construction methods are required for these two types of structures.

Extraction Well Completion

The depths at which the boreholes for the different extraction wells will terminate are detailed in Section 8.2.1.1. The well screens will consist of wire-wrapped stainless steel screen with 0.040 in. width slots. The well riser will consist of schedule 40 carbon steel. All screen and riser connections will be threaded. Steel centralizers will be placed on the screen and riser at 50 ft intervals to maintain the casing in the center of the borehole. Due to the consolidated nature of the tuff, it is not anticipated that a filter pack will be required in the borehole annulus surrounding the screen. A cement basket will be placed on the riser pipe approximately 5 ft above the top of the screen. This tool will allow for the setting of a 10 ft bentonite seal above the screened section of the well. This seal will consist of bentonite pellets or chips hydrated in the borehole in lifts of 6 in. Hydration will be performed using potable quality water.

The annular space above the bentonite seal will be filled to a depth of approximately 3 ft below grade with a bentonite cement grout. This grout will be placed in two stages. The initial grout placement will fill the annular space to a level approximately 20 ft above the top of the bentonite annular seal. This initial lift will be allowed to cure for approximately 24 hours before the balance of the annulus is grouted. This installation will provide a high-strength base to support the grout column within the annulus.

A protective steel or concrete box will be placed around the wellhead at the surface to house and protect the wellhead instrumentation. A typical wellhead configuration

is illustrated on Figure A-13. Wellhead configurations are discussed in Section 8.2.1.1.

Vapor Piezometer Completion

Completion depths for vapor piezometers are discussed in Section 8.2.1.2. The completion details for vertical piezometer installation are illustrated on Figure A-14A. Vapor monitor probes will be constructed of 1 in. ID stainless steel wire-wrapped well screen with a 0.040 in. width slot screen. Each of these probes will be approximately 1 ft long. The bottom of each probe will be sealed with a stainless steel plate. The upper end of the probes will be equipped with a threaded (1-2 in. F-NPT) fitting. A stainless steel tubing fitting will be used to attach 3/8 in. stainless steel tubing to this threaded fitting. This stainless steel tubing will extend up the borehole to the ground surface, where it will be equipped with a 3/8 in. stainless steel ball valve.

The deepest vapor monitor probe in each piezometer will be installed by suspending it from its tubing within the borehole to the installation depth. Coarse silica sand will then be poured into the borehole from the surface and allowed to settle around the probe to the depths illustrated in Figure A-14A. The annular seal separating this probe from the next, more shallow probe will then be emplaced. This seal will consist of 3 ft of bentonite chips or pellets, which will be hydrated in place in 6 in. lifts. This will be overlain by a bentonite cement grout, which will include an accelerator to promote rapid cure time. This grout will be emplaced through tremie pipe. Following the anticipated cure time of the grout, this seal will be tagged with the tremie to verify its solidity. If curing is sufficiently advanced, the installation process will continue with a second bentonite chip or pellet seal, installed identical to that described above.

Above the described seal, the next, shallower monitor probe and its filter pack will be installed, followed by the next annular seal. Their installation will be identical to that just described. This pattern will be repeated until the installation of the uppermost probe within each piezometer. When this probe, the filter pack, and the overlaying bentonite seal is in place, the remaining borehole will be filled to within 3 ft of the ground surface with bentonite cement grout (without accelerator). A protective steel or concrete vault will then be installed at ground level to house the piezometer instrumentation.

If the stainless steel tubing used for probe installation consists of sections of tubing joined with compression fittings, the fittings on the probe tubings must be protected from damage by the repeated installation and withdrawal of the tremie. This will be achieved through the use of a sheath of polyethylene tubing. This sheath will be placed over the stainless steel tubing following the probe installation. As the construction of the of the piezometer advances up the borehole, the polyethylene tubing will be gradually removed.

8.2.3 Manifold Piping

In order to protect the manifold piping connecting the extraction wells to the blower system from temperature extremes and mechanical damage, it will be placed in trenches below grade. The anticipated manifold layout for this pilot test is illustrated

on Figure A-12. The manifold piping will be constructed of 4 in. fusion-welded HDPE. Each extraction well will be connected to the blower system by an individual manifold pipe. These pipes will be set in a 2 ft-wide by 4 ft-deep trench which will be backfilled with sand.

Each pipe will be equipped with an in-line sump for the collection of line condensate. This sump will be placed at the low point of the line, and will be constructed to permit both the measurement of liquid levels and the period removal of accumulated liquids via a surface access.

Manifold piping will extend to the location of the blower above grade. Each of the four manifold pipes will be equipped with a 4 in. ball valve for adjusting flow rates, a vacuum pressure gauge with a range of 0 to 150 in. of water vacuum, and a threaded sample port. These sample ports will be used to collect samples for field VOC and O2/CO2 measurements and off-site analysis, and for the measurement of individual vapor flow rates using a hot-wire anemometer or equivalent. When not in use, each sample port will be closed up with a threaded plug. A more costly and accurate way to collect data on flow rates would be to use calibrated flow meters.

The extraction well manifold pipes will connect to an 8 in. diameter header as shown in Figure A-15. The blower header will then be connected to the suction side of the blower. This blower header will include a threaded sample port to allow for the collection of composite vapor stream samples.

8.2.4 Vacuum Pumps

The vacuum pump is the central operational unit of the VES. It provides the suction necessary to remove vapors and air from the subsurface, and the means to transport vapors to the emissions control system. Figure A-15 shows the blower and emissions treatment system in schematic. The pump(s) used for the pilot test will be capable of producing a vacuum of approximately 120 IWV at a nominal flow rate of 400 SCFM. The pump will be skid-mounted for ease of installation and movement.

The blower will be equipped with an explosion-proof motor; in-line pressure and temperature gauges on both the intake and discharge sides; and an air by-pass bleed valve to allow ambient relief air into the system as necessary. The pump system will also be equipped with an over-pressure sensor and relay on the discharge (positive pressure) side. This relay will shut the pump down if an overpressure situation develops due to a blockage of the discharge piping or treatment system. A vacuum relief valve will serve the same function on the suction (negative pressure) side of the system.

A particulate filter and air/water separator (knock out pot) will be used to control the entry of entrained particulates and moisture into the pump and emissions treatment system. Both will be placed on the suction side of the pump system, so that air is filtered and dewatered prior to entering the pump mechanism. The air/water separator will drain into an airtight auxiliary tank, which will be fitted with a vacuum equalization line to ensure the equilibration of pressures between the separator and the tank. This tank will have a 150 gal. capacity, and will be fitted with a high-water-

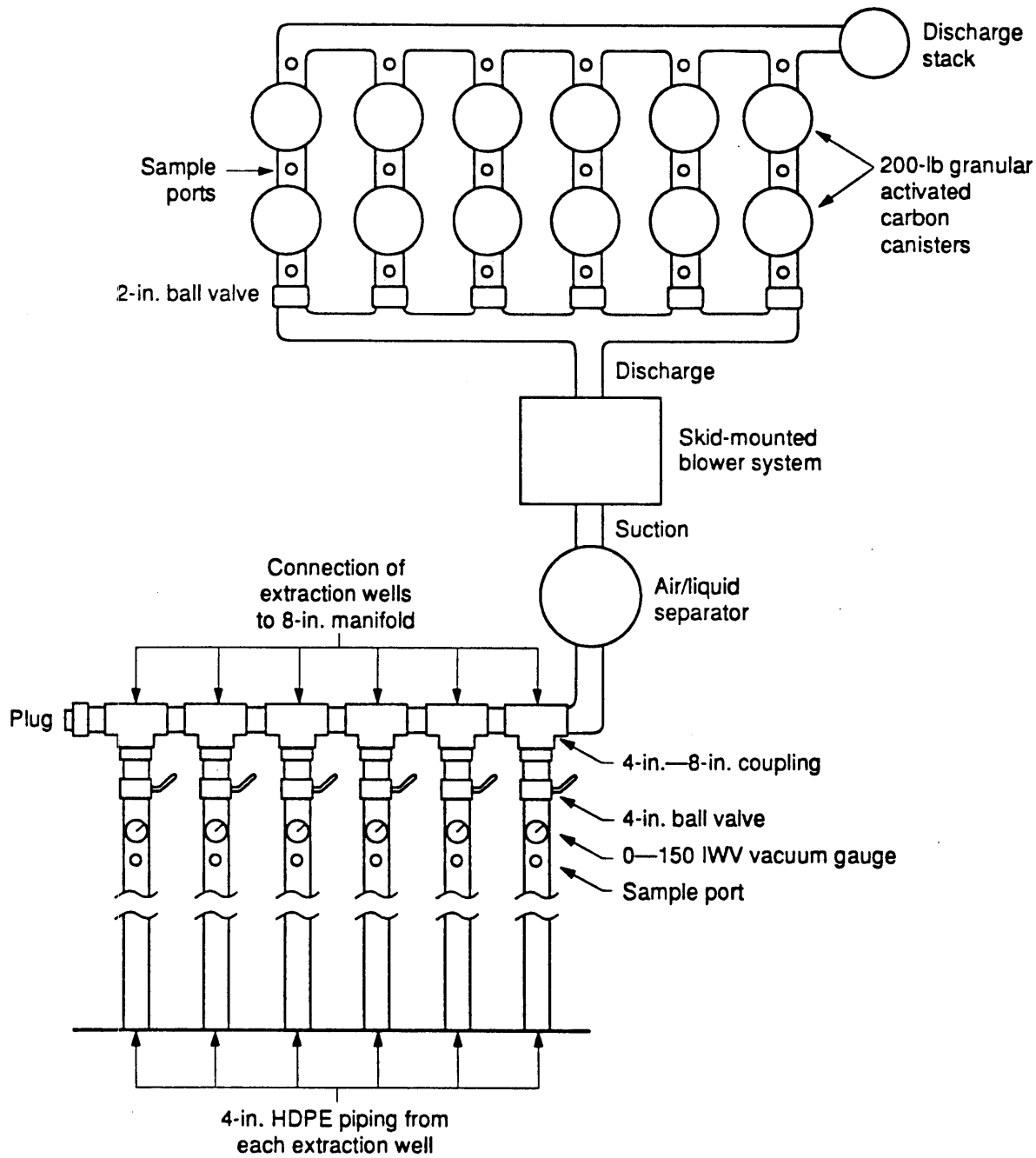

Figure A-15 General schematic of the blower and treatment system.

level sensor and relay, which will shut the pump system down in the event of an overfull situation in the tank.

8.2.5 Emissions Treatment and Discharge Systems

The extracted organic vapor stream and air will pass through an emissions treatment system prior to release to the atmosphere. This treatment system will reduce organic vapors in the effluent stream to levels allowable for discharge, as set forth in the air emissions permit (or equivalent) for the test. The treatment system will consist of eight 200 lb granular vapor-phase carbon canisters in the arrangement illustrated on Figure A-15. Because the discharged vapor from the pump is expected to be high in temperature (120° to 140°F), all piping downstream of the pump will consist of threaded galvanized iron pipe.

Each of the four parallel legs of the treatment system will be equipped with threaded sampling ports upstream, between, and downstream of the carbon canister pair. This will permit field evaluation of the hydrocarbon content of the treated vapor stream using an OVA. This will be the indicator parameter for determining when breakthrough and saturation of each carbon canister has occurred. When FID readings indicate that breakthrough has occurred on the first canisters of any given leg, this canister will be removed, and the remaining canister will be moved forward in that leg. A new canister will then be added in the downstream position. The discharge from the treatment system will be connected to a 6 in. diameter aluminum stack approximately 15 ft high. This stack will be secured via guy wires to prevent falling and subsequent damage to the discharge system.

The emissions system will be equipped with a sensor for the detection of any significant presence of radioactive vapors. Should such levels occur, shutdown of the blower will automatically occur, and an alarm signal will go off.

8.2.6 Data Acquisition System

In addition to instrumentation for various portions of the system, certain parameters will be continuously monitored and recorded using an electronic data acquisition system. The manifold piping system will be equipped with a system of sensors to monitor pressure, temperature, flow rate, and relative humidity. These same parameters will be monitored on the outflow of the pump, both upstream and downstream of the emissions treatment system. The sensor systems up- and downstream of the emissions treatment system will also include a flame ionization detector to monitor overall hydrocarbon content. In addition, an absolute barometric pressure transducer will be established to input a continuous or near-continuous record of barometric changes.

8.2.7 Utilities Required

The pump system for the VES pilot test is anticipated to require 230/460 volt AC, three-phase electricity provided at 60 hertz. Support and ancillary functions, such

as sensors, lights, utility outlets, etc., are anticipated to require 120/240 volt AC single-phase electricity at 60 hertz.

8.3 Pilot Test Operation

8.3.1 Startup Procedures

The initial step of the VES pilot test operation will consist of a brief trial run of the pump system. This will verify proper operation of the mechanical equipment and power supply, and permit the identification of potential problems prior to actual operation. The trial run will be performed with the control ball valves on each extraction well manifold pipe closed, and the air by-pass valve at the pump open. This configuration will permit the evaluation of the system's mechanical operation without the actual withdrawal of vapor from the subsurface. A trial of 20 min. duration should ensure the operational status of the equipment and power source.

Immediately prior to actual VES system start-up for the pilot test, the following operations will be performed:

- the extraction well control valves will be opened completely; and
- the air by-pass bleed valve on the pump intake will be opened.

The pump will then be started. The air by-pass valve can then be gradually closed to increase the vacuum pressures at the extraction wells.

8.3.2 Duration of Pilot Test

The pilot test will have a duration of two to four weeks. It is anticipated that two weeks will be sufficient to acquire the desired operational data. The additional two weeks may be utilized if it is determined during the test that the additional data supplied by this portion of the test is sufficiently valuable to warrant the additional effort and expense.

8.3.3 Operational Data Acquisition

The pilot test will be monitored by test personnel on a daily basis. Field data will be recorded on a regular basis, and will be maintained in a record format designed specifically for this test.

8.3.3.1 Parameters and Methods of Measurements

The following operational parameters will be monitored by test personnel during the pilot test:

- air flow velocity (ft/min) from each extraction well and at the pump suction, discharge, and air by-pass valve;
- wellhead vacuum pressures, manifold pressures, and pump suction/ discharge pressures;
- air temperatures at the pump suction and discharge;
- drawdown pressures at the piezometers;
- volume of water within the condensate tank on the pump;
- field VOC content upstream of the pump, and upstream and downstream of each carbon canister; and
- the water level within each of the extraction well manifold sumps.

During the first week of the test, the wellhead pressures will be varied to at least three different levels. The rate and magnitude of the response in flow rates, drawdown pressures, and VOC concentration will be monitored until these parameters stabilize.

Flow Rate

A velocity meter (hot-wire anemometer) will be used to measure the air flow velocity at each of the extraction well manifold pipes leading to the pump header. The threaded sample ports on this piping will allow access of the meter. When the probe is inserted into the piping for measurement, the sampling port will be sealed with a gasket or bushing to prevent erroneous measurements caused by the leakage of outside air through the port past the probe. The velocities, in feet per minute, and the piping area will be used to calculate the flow rate, in cubic feet per minute.

Vapor Extraction Pressures and Temperatures

Extraction vacuums and discharge pressures created by the pump system will be monitored through the use of pressure gauges located at strategic points on the system. This will include the wellhead, the manifold piping, the pump suction upstream and downstream of the particulate filter, and the pump discharge. An intake and a discharge temperature gauge will also be located on the pump to monitor the air temperature increase across the pump.

Piezometer Pressure Response

Prior to system startup, vertical manometers will be constructed for each of the vapor monitor probes. Figure A-16 illustrates a conceptual schematic of each manometer arrangement. Within each piezometer enclosure, therefore, three separate manometers will be assembled and labeled according to the depth of their associated probe. One side of the manometer tubing will be open to the atmosphere; the other side will be connected to the probe tubing. The manometer tubing will be filled with a colored meniscus-free liquid, and the manometer will be leveled in all three dimensions.

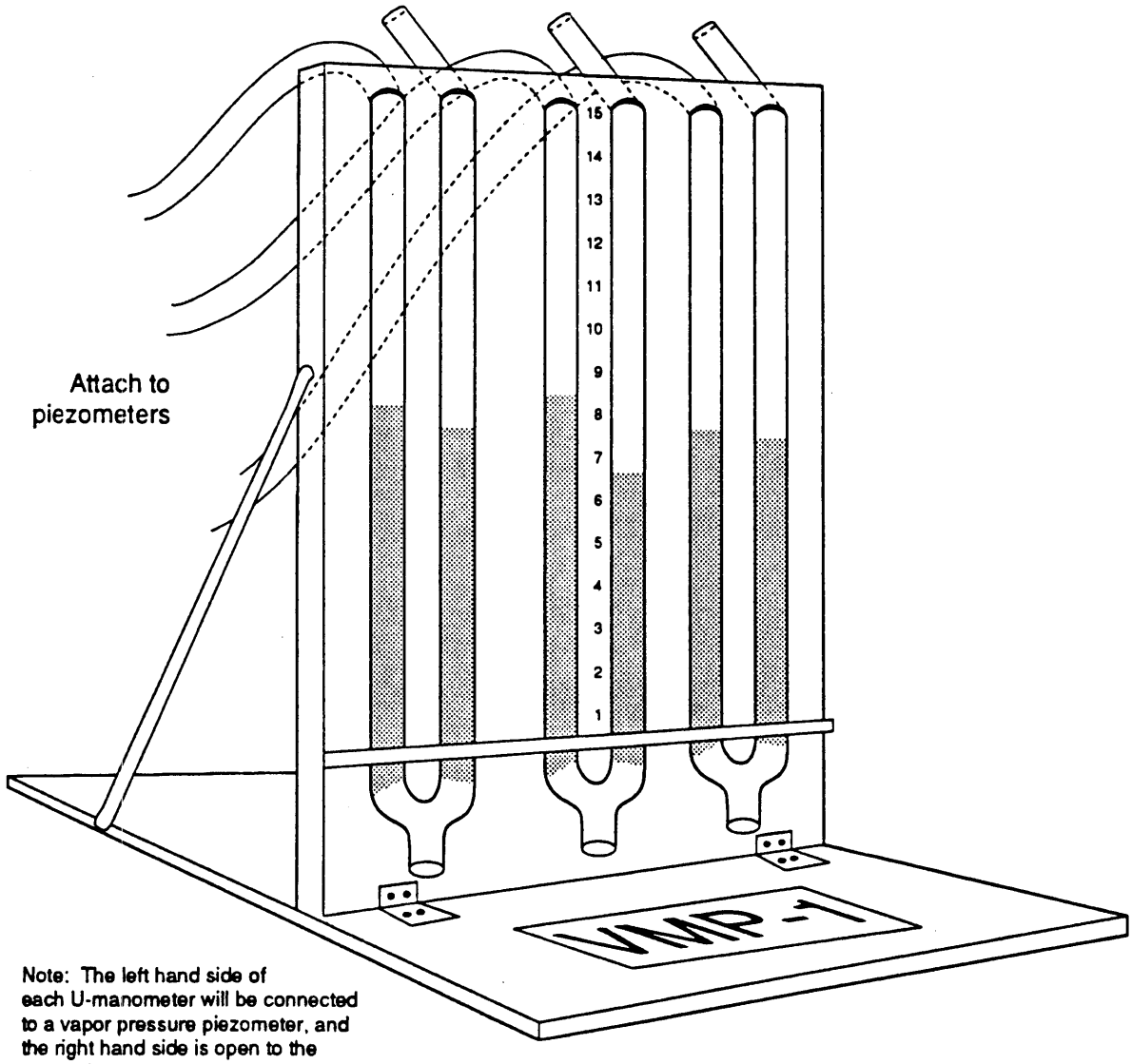

Figure A-16 Schematic of each manometer set-up.

Pressures at each manometer will be read in increments of 0.05 in. of water vacuum. A continuous and detailed record of barometric pressures at the site will be taken during the test duration to permit the correction of piezometer response for barometric changes. This record will be acquired using an absolute barometric pressure transducer recording hooked up to the electronic data acquisition system. A more costly and accurate alternative to liquid manometers would be to utilize differential pressure transducers linked up to the electronic data acquisition system.

VOC Content

A FID type of OVA will be used to measure VOCs at the wellheads, at the piping entering the pump, and upstream and downstream of each carbon canister. Measurements will be acquired by using a sampling pump to transfer an aliquot from the airstream within the pipe to a gas sample bag. The probe of the OVA will be inserted directly into the sample bag. Measurements will be read in either parts per million by volume or in percent by volume. In addition, a field gas chromatograph will be used to continually monitor total VOC concentrations at the piping entering the pump. Individual vapor samples analyzed in the laboratory will be used to correlate this data.

In addition to the field measurements, samples will be collected from each wellhead and from the pump intake (for a composite sample) and analyzed off-site in order to determine the composition and concentrations of the various components of the vapor stream. Details regarding the collection and analysis of these samples are provided in Section 8.4. A FID reading will be collected concurrently in order to provide data regarding the correlation between the two types of readings.

If analytical turnaround permits the use of off-site analysis to evaluate the effectiveness of the emissions treatment system during the test performance, then this method will be utilized. If turnaround is not rapid enough to permit approximate "real time" evaluation of emissions quality using this technique, then the evaluation will be estimated in the field using a FID.

Production Rate of Condensate/Entrained Water

It is anticipated that some condensation and entrained water will be produced from the airstream during the test. This water will be collected in the extraction well manifold sumps and in the knock out tank attached to the air/water separator on the pump. The amount of water within the tank on the pump and in the sumps will be regularly measured to determine the production rate of condensate. Water levels in the sumps will be collected using an electric water level indicator (E-line) or other similar device. Water levels within the knockout tank will be determined by direct measurement of the depth of water in the tank.

If the sumps and/or knockout tank fill completely during the test, they will be drained. The sumps will be pumped out via the suction lines installed for that purpose. The pump knockout tank will be gravity drained or pumped to drain. All condensate/entrained water collected and removed will be placed into appropriate containers, labeled, and disposed of properly.

8.3.3.2 Frequency of Measurements

Flow rates, pressures, and VOC content will be measured and recorded once within the first 15 min of operation, and twice hourly thereafter for the initial four hours of operation. After the initial four hours, these parameters will be measured and recorded at least three times daily for the balance of the test. Measurement frequency will be increased as needed to adequately document the rate and magnitude of changes during

- the portion of the test when parameters are varied to monitor the interdependence of operational parameters (see Section 8.3.3.1); and
- when any operational parameter is varied for any other reason, such as simple adjustments to the system.

The frequency of measurement of the parameters may be modified, with project manager approval, as deemed necessary to ensure a complete data record of the pilot test.

8.3.4 Disposition of Side Wastestreams

The following side wastestreams are anticipated to be produced during the test:

- drill cutting solids,
- granular carbon from the treatment of air emissions during drilling and vapor extraction, and
- waters from condensate, also possibly from the drilling process.

All wastes will be containerized and maintained on-site during the test. Following characterization, these will be disposed of using appropriate methods.

8.4 Sample Collection for Off-Site Analysis

This section details the collection procedure for samples requiring off-site analysis. Sampling for on-site analysis, such as the FID measurements discussed in Section 8.3.3.1, will not be discussed here.

Samples of the tuff will be collected for lithologic description. Geochemical analyses, and laboratory tests for sorbtion properties and unsaturated hydraulic properties will be conducted.

8.4.1 Collection Rationale

Vapor samples will be collected from the piezometers prior to the pilot test to supplement the existing data regarding the extent of contamination both laterally and

vertically within the project area. The samples will be analyzed for all suspect contaminants. After the commencement of the vapor extraction test, samples will be taken as described to determine the amount and rate of contaminant removal.

8.4.2 Sample Collection Procedures

Media to be Sampled

Sampling will be performed on piezometer and extraction system vapor samples, as well as on the side wastestreams identified in Section 8.3.4. Because the sampling of side wastestreams will be for disposal characterization rather than for parameters which directly affect the evaluation of the test, the collection of side wastestream samples will not be discussed in detail within this discussion of sample collection procedures.

Location of Sampling Points

Vapor samples will be collected from all of the piezometer vapor monitor probes prior to startup of the pilot test to provide information on background conditions. Following the startup of the test, samples will be collected from the sampling ports at the extraction wellheads or individual manifold pipes, at the manifold header (to provide a composite), and downstream of the emissions treatment system.

Frequency of Sampling

The frequency of sample collection from the selected sampling points is detailed in Table A-13. Within the first 15 min of the test, one vapor sample will be collected at the manifold header. After 24 hours, the header will be resampled, and five additional samples will be collected: one from each of the extraction well manifold pipes, and one from downstream of the emissions treatment system. These locations will be resampled every 48 hours thereafter until the conclusion of the test. A final set of samples will be collected from all of the vapor monitor probes and from the upstream and downstream locations from the carbon canisters immediately before system shut-down. This sampling frequency may be increased or reduced by the test supervisor based on test or field conditions.

Sampling Methods

Vapor samples will be collected within stainless steel evacuated canisters. Samples will be collected by connecting the canister to the sampling port using a short length of stainless steel tubing. This tubing will be flushed with breathing-quality air prior to each use to remove any possible residual of VOCs. The sample tubing will connect to the canister through an in-line particulate filter. Since the canister is evacuated, the sample can be collected by slowly opening the control valve on the canister and allowing an aliquot to be drawn from the airstream within the piping. The pressure within the piping at the sample location will be noted on an attachment to the request for analysis accompanying the sample to the laboratory. This will permit the analysts to correct concentrations for the reduced pressure within the pipeline.

TABLE A-13
FREQUENCY OF SAMPLE COLLECTION

Sample Interval	Sample Location	Samples per Location	Total # of Samples
Startup - within 15 min	Manifold header	1	1
At 24 hours and repeated every 48 hours	Manifold header	1	1
	Each extraction well manifold pipe	1	6
	Downstream of emissions treatment system	1	1
Immediately prior to system shut-down	Manifold header	1	1
	Each extraction well manifold pipe	1	6
	Downstream of emissions treatment system	1	1

Sampling Documentation

All sampling events will be documented in the test log maintained at the site throughout the duration of the test. This documentation will include records of the sample locations, sample time, the identity of the samplers, and other pertinent information. All samples transferred off-site for analysis will be accompanied by appropriate chain-of-custody and request for analysis documentation. This documentation will detail the sample identity, the desired analyses, and any special considerations. Proper chain-of-custody will be maintained throughout the sample collection, storage, and transport sequence.

Quality Assurance Sampling

In order to permit data verification, duplicate samples will be collected for 10 % of the vapor samples.

8.4.3 Analytical Methods

All vapor samples will be analyzed for the following constituents:

- oxygen,
- carbon dioxide,
- carbon monoxide,
- nitrogen,
- non-methane organic carbon, and
- methane.

In addition, vapor samples will be analyzed for SW 846 VOCs as well as for any tentatively identified compounds noted during the analysis. Analyses for the major gases listed above will be performed using ASTM Method D3416. Analyses for VOCs will be performed using SW 846 protocols.

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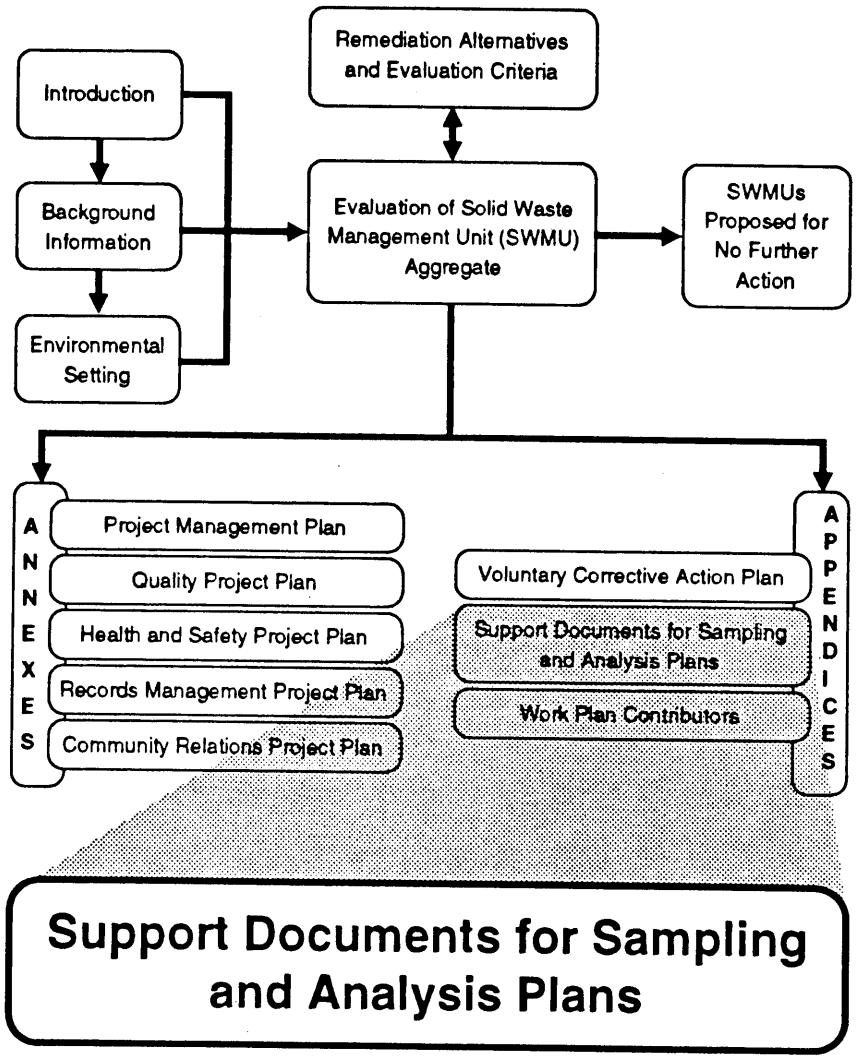
APPENDIX B


Introduction
Background Information
Environmental Setting
Remediation Alternatives and Evaluation Criteria
Evaluation of Solid Waste Management Unit (SWMU) Aggregate
SWMUs Proposed for No Further Action
ANNEXES
Project Management Plan
Quality Project Plan
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Work Plan Contributors
Support Documents for Sampling and Analysis Plans

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1.0 Surface Water Runoff Sampling Procedure

Surface water runoff sampling will be conducted at Material Disposal Areas (MDAs) J, H, L, and G. Sampling will be done with an ISCO® 3700 Series Wastewater Sampler.

1.1 Setup Procedure

To operate the sampler, prepare the base section, attach the suction line, connect a power source, install the sampler at the site, place the suction line inlet in the surface water source, and enter an external flow meter (if used).

1.2 Programming the Sampler

The sampler can be programmed on site or in an office, and the setting may be changed at any time. The sampler has three operating states:

- "STANDBY" state: the sampler is waiting for instructions from the keypad;
- "RUN" state: the sampler is running a sampling routine, displaying status messages on the LCD, and storing sampling results in memory; and
- "INTERACTIVE" state: the sampler is being programmed.

1.3 Programming and Sampling Procedures

Before programming the sampler, check the configure option setting. Press the LEFT ARROW or RIGHT ARROW key at the SELECT OPTION display in the configure sequence to scroll through the list of options, viewing each input display. When you arrive at the option you want to access, press the ENTER/PROGRAM key. Press the EXIT PROGRAM key to return to the list of configure options without changing the setting.

Procedure:

1. Identify the number and size of the bottles. Determine the inside diameter, type, and length of suction line. Convert the sampler to composite sampling if necessary.
2. Turn the sampler on with the ON/OFF key. The STANDBY message will appear.
3. Check the configuration setting with the ENTER/PROGRAM key. Select CONFIGURE to access the configure sequence. Check the bottles, sizes, and suction line options settings to make sure they match those in Step 1. Select the BASIC key in the programming mode configure option. Press the EXIT PROGRAM key to return to STANDBY.

4. From STANDBY, press the ENTER/PROGRAM key to access the INTERACTIVE state. Select PROGRAM to access the program sequence.

5. Enter the sample pacing setting. Select either time- or flow-pacing. Then enter the time- or flow-pulse interval between samples.

6. Enter the sample distribution setting. The first display of the sample distribution section asks if you want multiplex samples. Select NO for sequential sampling; the sampler will then prompt you for the sample volume setting.

   Select YES for multiplexed sampling. The next display will prompt you to select either BOTTLES PER SAMPLE or SAMPLES PER BOTTLE.

7. Enter the sample volume setting. Because the programmed sample volume is a "nominal" value, enter a volume somewhat less than the capacity of the bottle to minimize the effect of cumulative error.

8. Enter the key time setting. You will be asked if you want to enter a start time for the routine. If you select YES, there will be a prompt for the start time and date. If you select NO, the sampler will use the start time delay.

9. The sampler will automatically return to STANDBY.

10. Press START sampling to start the sampling routine. Enter the starting bottle number. If no response is made within 60 seconds, the sampler automatically begins with bottle number 1. If the routine starts after the programmed start time, the sampler will allow for a new start time to be entered.

11. Use the RUN state display to monitor the sampler's progress.

12. The sampler will display DONE when it has completed a program.

13. Access to the program setting and the results of the most recent sampling routine may be displayed by using the DISPLAY STATUS key. Display status information remains in memory until the start of another program.

14. Select RESULTS to view the results of the sampling routine. The LEFT and RIGHT ARROW keys may be used to move through the results. The results include the following items: program start time, date, sample volume, source of each sample event, cause of each missed sample, start time of each sample, number of pump counts to liquid detection for each event, pumping time for each sample event, and time routine was completed.

Collected samples will be screened in the field for organic vapors and ionizing radiation.

1.4 Preservation Technique to be Used

1. Seal in shipping container with Chain-of-Custody/Request for Analysis form enclosed in a Ziploc® bag taped to the inside of the lid.
2. Ship to the Sample Coordination Facility (SCF) on the day of collection.
3. Store at 4° C.

2.0 Surface Sediment Sampling Procedures

Surface sediment and soil sampling will be conducted at MDAs J, H, L, and G, and at the TA-51/54 Septic System SWMU Aggregate.

2.1 Sampling Methods

Samples will be collected in accordance with LANL-ER-SOP-06.14, "Sediment Material Collection."

2.1.1 Sediment Sampling Using Stainless Steel Scoops or Trowels

1. Insert a decontaminated scoop or trowel into the material and collect the sample. Record any pertinent information (e.g., location, sample size) on the Daily Activity Log.
2. If compositing a series of grab samples, use a decontaminated glass or stainless steel mixing bowl to combine samples.
3. Remove all nonsoil material from the sample prior to mixing.
4. Exception to SOP: When sampling for non-VOC samples, mix the sample in the following manner:
   - Mix the material in a bowl, smooth out, remove organic materials and coarse fragments, and create four sample piles.
   - Mix each quarter pile thoroughly, then proceed to next quarter pile in a clockwise fashion.
   - Recombine all quarter piles and mix the combined sample.
   - Requarter the sample and remix.
5. Transfer the sample into an appropriate sample container.

2.1.2 Sediment Sampling Using a Cork Borer for VOC Samples

This method is an exception practice to LANL-ER-SOP-06.09, "Spade and Scoop Method for Collection of Soil Samples."

1. Use a stainless steel cork borer with an outside diameter slightly smaller than the inside mouth diameter of the 40 ml glass VOC sample container.

2. Push the borer into the material with a smooth continuous motion, twist and then withdraw in a single, smooth motion. Record any pertinent information in the Daily Activity Log.

3. Remove the sample by extruding it with a hardwood dowel. Place a layer of baked aluminum foil (300° F) in the space between the sample and the dowel.

4. Extrude the sample directly into a 40 ml sample container.

5. Secure the cap and place custody tape around the cap and vial but not over the septum.

6. Label the sample and place it in a Ziploc® or equivalent bag, then chill.

2.2 Sediment Sample Documentation and Handling

The following procedures apply to all sampling methods:

1. Complete the Chain-of-Custody/Request for Analysis forms as required by LANL-ER-SOP-01.04, "Sample Control and Field Documentation."

2. Complete the rest of the forms required by LANL-ER-SOP-01.04.

3. Pack the sample containers in the shipping container in a manner that prevents breakage (LANL-ER-SOP-01.03, "Handling, Packaging, and Shipping of Samples").

4. Record the number of the Chain-of-Custody/Request for Analysis forms on the Daily Activity Log and seal the Department of Transportation (DOT)-approved shipping container.

5. Complete the sample collection log; make appropriate notations on the Daily Activity Log.

6. Transport the shipping container to the SCF on the day of collection.

2.3 Preservation Technique

1. Seal in shipping container with Chain-of-Custody/Request for Analysis form enclosed in a Ziploc® bag taped to the inside of the lid.

2. Ship to the SCF on the day of collection.

3. Store at 4° C.

3.0 Borehole Installation and Sampling Procedures

Boreholes will be installed in Material Disposal Areas J, H, L, and G during the Phase I investigation at each area. A detailed tabulation of borehole sample intervals and analyses to be performed at each interval is given in Tables B.3-1 (MDA J), B.3-2 (MDA H), B.3-3 (MDA L), and B.3-4 (MDA G), located at the end of this section.

3.1 Excavation Permits

As part of the Environment, Safety, and Health (ES&H) Questionnaire process, excavation permits are required by the Laboratory prior to any excavation, drilling, or other invasive activity. Acquisition of the permits will be coordinated with Health and Safety 3 (HS-3) and Johnson Controls World Services Inc. (JCI). Acquisition of excavation permits will be scheduled as appropriate for each phase of field work. All areas intended for drilling and sampling will be marked in the field for formal clearance prior to work.

3.2 Borehole Installation

Boreholes will be advanced by either hollow stem auger (HSA) or air rotary coring techniques using a Longyear Model 44 or equivalent drill rig. Boreholes advanced with hollow stem augers will use 7.625-in outside diameter by 4.25-in inside diameter augers. Core samples will be collected with a 3.25-in inside diameter 5-ft-long split barrel continuous sampling tube. A wireline retrieval system will be used to return the sampling tube to the surface. If refusal occurs with HSAs before the plume is intersected, air rotary drilling techniques will be employed to continue the borehole. Boreholes continued by air rotary drilling techniques will be reamed to maintain a constant borehole diameter.

Boreholes advanced by air rotary coring techniques will be continuously purged with air or an inert gas that does not contain any VOCs. Core samples will be collected in 5-ft sections using a Christensen HQ or 94-mm wireline core barrel system or equivalent. The core barrel will be returned to the surface using a wireline retrieval system. The 94-mm wireline core barrel system will produce a core diameter of 2.4 in and a borehole diameter of 4.25 in. In the event that significant sloughing or loss of circulation occurs with the air rotary drilling technique, ODEX or TUBEX casing will be temporarily inserted into the borehole as it is advanced.

Boreholes will be numbered according to the numbering system previously used at TA-54 (IT Corporation 1987, 0327). The first letter in each hole number, L, refers to Los Alamos. The second letter, G, H, J, or L, refers to the MDA in or near which the hole is located. The third letter indicates the primary purpose for which the hole was drilled:

- C: Core and Pore-Gas Sampling Holes - To be used when collecting samples for hazardous and radionuclide contaminant analysis, and for the installation of pore-gas sampling apparatus.

- S: Surge Bed Core and Pore-Gas Sampling Holes - To be used when collecting samples for hazardous and radionuclide contaminant analysis.

The middle designation, 92, indicates the year that the test holes will be drilled. For the purposes of this plan, it is assumed that the boreholes will be drilled in 1992. The final two digits refer to the drilling sequence. Boreholes in which new vapor monitoring wells will be installed will be numbered beginning with the number following the highest numbered existing vapor monitoring well. Boreholes which will be abandoned after drilling will be numbered sequentially beginning with the number one.

A geologist will be present during drilling operations and will maintain a detailed log for each borehole. Consult LANL-ER-SOP-06.12, "Soil and Rock Borehole Logging and Sampling Methods," for information on completing the borehole log. The borehole log should include the following information:

- Detailed core description including:
  - Rock Type,
  - USCS classification,
  - Color,
  - Mineralogy,
  - Bedding thickness,
  - Grain or crystal size,
  - Hardness,
  - Weathering, and
  - Moisture content - listed as an adjective (e.g., dry, moist, wet);

- Location of any fractures, joints, bedding planes, faults, cavities, or weathered zones intercepted during sample retrieval;

- Fracture orientation and spacing;

- Location of mineralized zones indicating the minerals present;

- Difficulties encountered during drilling;

- Radiation screening monitoring results;

- PID, FID, or ECD monitoring results;

- Depth/elevation of sampling interval;
- Sample recovery/sample length;
- Equipment details including type of drill rig, type of drill bit, and sampling method;
- Drilling fluids used: filter type for compressed air;
- Drilling sequence and comments;
- Depth/elevation of hole diameter changes (bit changes) and temporary casing;
- Total depth of completed boring;
- Depth of any grouting or sealing and the amount of cement and/or bentonite used;
- Depth or location of any loss of drill air circulation, tools, or equipment;
- Identification numbers for samples, blanks, and duplicates;
- Date, time, and conditions; and
- All other pertinent information.

3.3 Sample Collection From Vertical and Angled Boreholes

3.3.1 Rock Core

Continuous collection of core material throughout the length of each borehole will be conducted for lithologic logging and sampling purposes. Core samples will be collected in 5-ft sections for various analyses and measurements in the field and the laboratory.

Immediately upon the retrieval of core from a borehole, the Radiation Protection Technician and Site Safety Officer will scan the core barrel for radiological constituents and VOCs. The results will be recorded on the Sample Collection Log. If radioactivity or organic vapors are detected, refer to Figure B-1, "Sample Management Decision Flow Chart," and Figure B-2, "Site Radiological Survey Decision Flow Chart," for instructions. Otherwise, continue with sample collection efforts. Carefully remove the core from the barrel. If a split tube inner core barrel is not being used, use a clean, decontaminated stainless steel core tray to log the core. The core tray length should exceed the length of the expected maximum core run. The ends of the core tray should be marked "TOP" and "BOTTOM" to provide a continuous orientation of the core. When the core is soft or broken, it will be carefully pushed into the core tray. Scan the core for VOCs and radiological contaminants. Collect

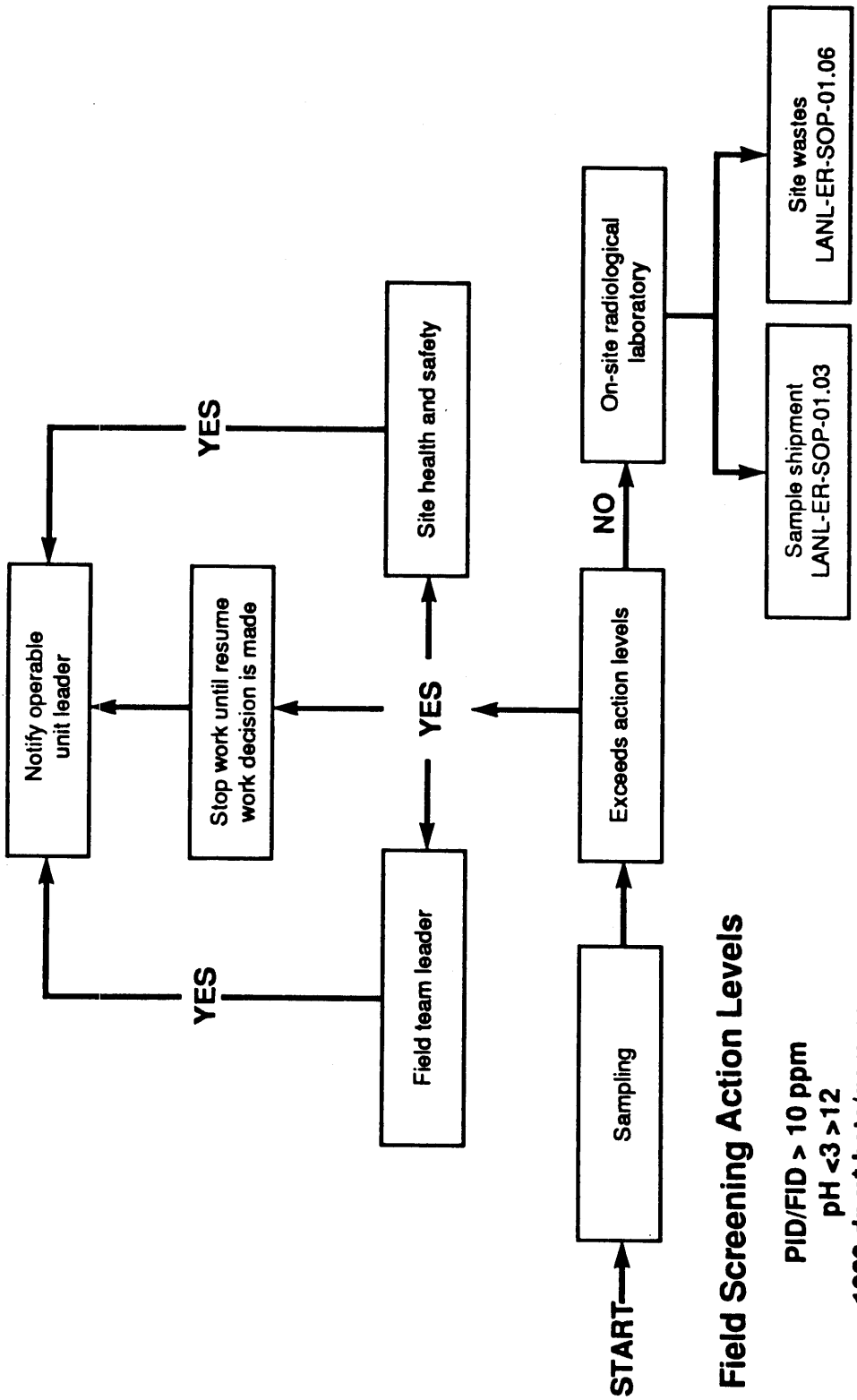


Figure B-1 Sample management decision flow chart.

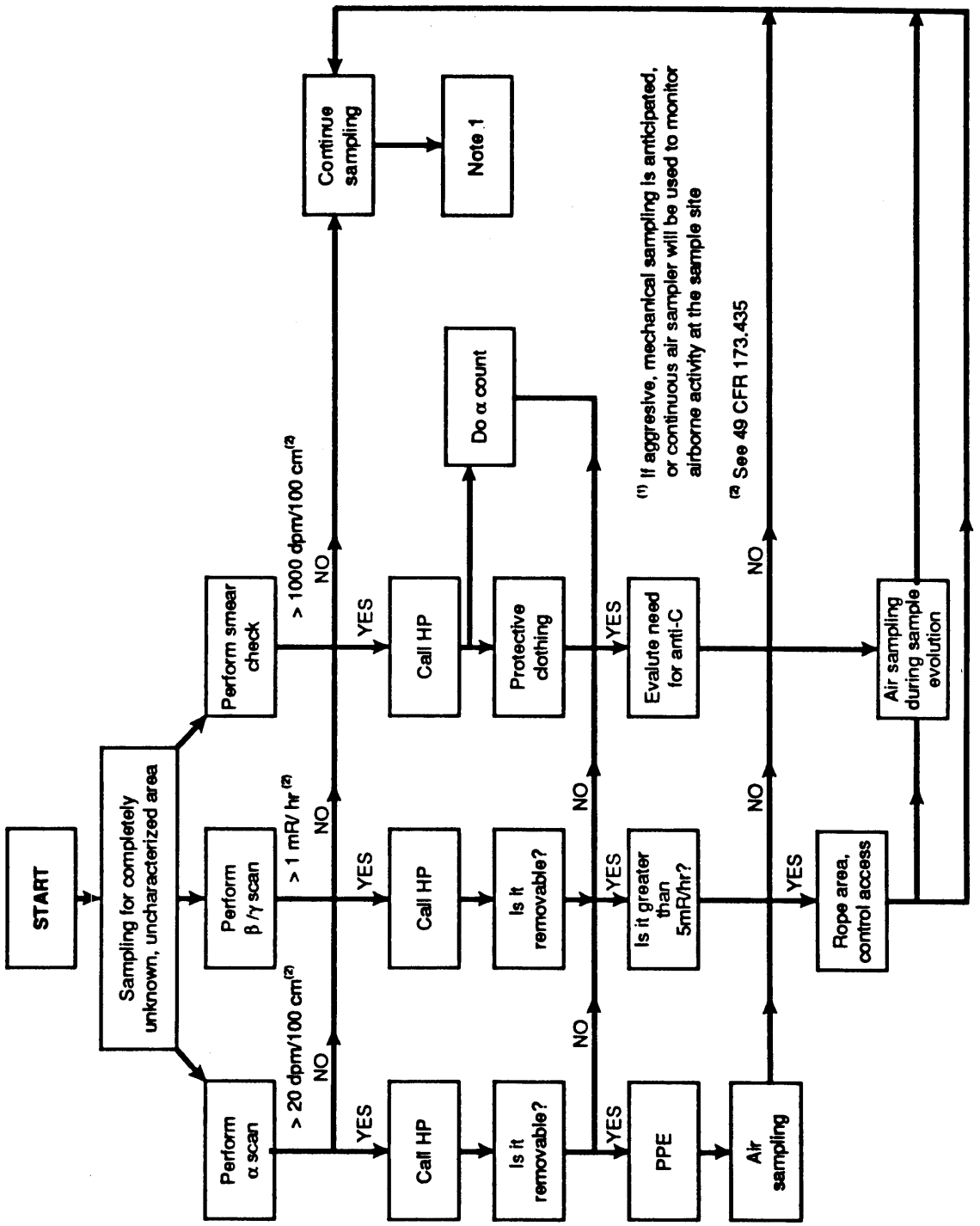


Figure B-2 Site radiological survey decision flow chart.

samples for field and laboratory analysis and log the core. Sample container and volume requirements are presented in Section 9.0 of Appendix B, Table B.9-1. Upon completion of logging the core, transfer the rock core to a core box. Cores should not sit outdoors for long periods of time, and never overnight.

Core boxes will be well constructed wooden boxes, or equivalent, as approved by the Laboratory's Curation Facility. The boxes will be constructed so that the inside dimension of the box between the bottom and the lid is only slightly larger than the core diameter. Within the core boxes, wooden spacers, equal to the height of the box, will be provided to separate the rows of core. The spacers will be fastened within the box. Provisions for the box lid to be securely fastened to the box will be made. The lid should be screwed to the box after the box is filled, but latches may be used with the approval of the Laboratory Field Team Leader (FTL). The boxes will be constructed so that they may be stacked when filled with core.

At the end of each core run, wooden spacer blocks will be placed in the core box to separate runs. These blocks will be permanently attached to the core boxes with nails, if appropriate. The spacer block at the end of a core run will be indelibly marked with the depth from the surface to the bottom of the core run. In addition, if portions of the core have not been recovered, or if core has been removed for laboratory testing, a two-space partition will be placed in the interval where core is assumed to have been lost or has been removed. These partitions will be permanently attached to the core boxes and marked with the depth interval represented. The sample identification number will also be indelibly marked on the partition. The core boxes and longitudinal spacers should be dimensioned and constructed to accommodate 16 ft of core (four rows of 4 ft each). Other size boxes may be used with the permission of the FTL.

Core boxes will be indelibly labeled on each end, the front side, and the inside and outside of the lid. The label will include the project name and number, boring number, depth interval from which the contents were recovered, and box number. The amount of core recovered, as a percentage, may also be marked on the box. The core boxes for each boring will be numbered consecutively from the top of the boring to the bottom, with the total number of boxes for the boring also indicated, such as Box___of___. On the inside of the lid, the following additional information may also be shown in tabular form: run number, depths covered in the run, recovery, percent recovered, rock quality designation (RQD), date, and time. Boxes are to be labeled as the core is placed in them.

Core from more than one drill hole will not be put in a core box. Under no circumstances are the core samples to be transferred to other boxes without the approval of the FTL and the presence of Laboratory personnel. Core boxes and their contents will be photographed in a timely manner prior to the core being removed from the site. The photographs should clearly show the core and the information printed on the inside of the box lid.

Core boxes will be handled and shipped carefully to minimize disturbance of the core. The boxes will be protected from excessive moisture, heat, and freezing. If core boxes must be stored temporarily on site, they will be protected from adverse weather. Site storage facilities must be approved by the FTL and will be indoors,

where possible. The core boxes may be stacked, but it must be done so that the markings on the box front or end can be read easily, and so that all of the boxes are accessible.

3.3.2 Rock Core Field Analyses Procedures

Rock core samples will be analyzed in the field for headspace analyses for VOCs with a Photoionization Detector (PID) or Flame Ionization Detector (FID), an organic vapor analyzer, and a portable Gas Chromatograph (GC). Core samples for headspace analyses will be collected at 5-ft intervals. Radiological samples will be collected for field laboratory analyses by a windowless Gas Flow Proportional (GPF) counter and a liquid scintillation counter.

3.3.2.1 PID/FID Headspace Analysis

Analysis for organic vapors with a PID or FID will be conducted according to the method described below. However, if a PID is used for the analysis, an 11.7 eV lamp should be installed in the detector. The method is as follows:

1. Break a section of the core into pieces.

2. Place the broken section of the core in a 500-ml/16-oz glass jar or a Tedlar® bag with a Teflon® valve.

3. Seal the top of the jar with Teflon® or a nonvolatile plastic wrap, such as Tedlar®. If a Tedlar® bag is used, either roll the bag securely and fasten with rubber bands or heat seal it shut.

4. Heat the core to a temperature of 15° to 25°C to release the vapors.

5. Pierce the seal of the jar with the probe of a PID or FID organic vapor analyzer and note the highest (peak) reading. If a Tedlar® bag is used, attach the PID or FID probe to the valve with medical grade silicon tubing and note the highest reading.

6. Record the results and any pertinent observations on the Sample Collection Log and boring log.

3.3.2.2 Portable GC Headspace Analysis

Organic vapors will be collected in Tedlar® bags and analyzed with a portable Gas Chromatograph in the field analytical laboratory. Core samples for headspace analysis with a Gas Chromatograph will be collected at 5-ft intervals.

3.3.2.3 Windowless GFP Counter/Liquid Scintillation Counter Analysis

Analysis for radionuclides will be conducted by analyzing for low-level alpha, beta, and gamma emissions with a windowless Gas Flow Proportional counter or equivalent system. Two potential systems are the Tenelac® Frish Grid Chamber for alpha and beta emissions with a shielded NaI detector for gamma emissions or a Tenelac® LB 5100 Series III counter with a gamma option for alpha, beta, and gamma emission detection. Analysis for tritium will be conducted with a liquid scintillation counter. A Tri-Carb® 1000 Liquid Scintillation Analyzer or equivalent unit will be used to analyze for tritium. Core samples will be collected for analysis at 5-ft intervals.

3.3.3 Hydrogeologic Measurements

Rock core samples will be collected for determination of gravimetric water content at 5 ft intervals. A quantitative measurement of water content will be determined in undisturbed core by weighing the moisture loss due to oven drying according to ASTM method (ASTM D-4531).

3.3.4 Downhole Geophysical Surveys

Downhole geophysical logs will be performed on both vertical and angled boreholes to enhance information obtained from geologic descriptions and improve stratigraphic correlation. The logs will help identify and map the orientation of fractures and joints and define the relative variation in moisture and bulk density. All geophysical logs will be performed in accordance with either LANL-ER-SOPs or standard field practices. The following geophysical logging procedures will be performed:

- gamma density log,
- thermal neutron log,
- caliper log,
- axial borehole video log,
- EM induction log, and
- natural gamma log.

3.4 Waste Disposal/Borehole Abandonment

Waste generated during drilling and sampling operations, including cuttings, will be disposed of in accordance with LANL-ER-SOP-01.06, "Management of RFI-Generated Waste." Similar types of wastes should be segregated and placed in separate drums for characterization and disposal. Expected types of waste materials include personal protective and sampling equipment, decontamination liquids, drilling debris, and borehole cuttings. The instructions on Figure B-3, "Decision Flow Chart for the Management of ER Program Waste Generated During the RFI," contain procedures pertaining to disposition of wastes.

Specific action levels, such as 10 ppm for VOC screening and 1,000 dpm for radiation screening, have been developed for guidance in handling sample and waste material generated during the field program. The decision path on Figure B-1, "Sample Management Decision Flow Chart," describes what to do after screening material for contamination.

Drums will be identified with a paint marker or other permanent marking device (other than indelible ink or similar markers which fade in sunlight). The drums should not be labelled on the top, and the labels should include type of material, Operable Unit identification number, Technical Area number, disposal area identification, boring number or numbers, contact group and telephone number. The drums will be placed in a temporary storage area designated for this purpose.

Boreholes will be abandoned by grouting with cement and bentonite. Bentonite should not exceed 6% by weight of the grout mixture, and cuttings should not be returned to the borehole.

3.5 Survey of Borehole and Vapor Monitoring Well Locations

All borehole locations will be staked upon completion of borehole installation to facilitate subsequent surveying. The elevation of these points will be determined to the nearest 0.1 ft. The location of each borehole will be measured from permanent site features which will allow for later relocation of all sampling locations. These measurements will be shown on a site plan and recorded in the surveying notebook. Coordinates and elevations will be established for each borehole and vapor monitoring well installation. The coordinates will be to the closest 1.0 ft and referenced to the State Plane Coordinate System. A ground elevation to the closest 0.01 ft and an elevation for the top of the sampling port to the closest 0.01 ft will be obtained at each vapor monitoring well installation. These elevations will be referenced to the National Geodetic Vertical Datum of 1928 (Mean Sea Level), or an existing local vertical datum. The location, identification, coordinates, and elevations of the vapor monitoring wells will be plotted on maps with a scale large enough to show their location with reference to other structures at the individual sites. A tabulated list of the vapor monitoring wells, copies of all field books, and all computation sheets will be prepared and submitted to the Records Information Center. The tabulation will consist of the designated number of the vapor monitoring well, the X and Y coordinates, and all required elevations. These items will be submitted in the Draft RI Report.

3.6 Field Screening

Screening measurements will be taken at the point of sample collection, in the borehole headspace, and in the breathing zone to identify gross contamination and to assess conditions affecting the health or safety of field personnel. Application of screening for personnel health and safety is detailed in the Health and Safety Plan. Every sample collected will be screened for gamma radioactivity, gross alpha and

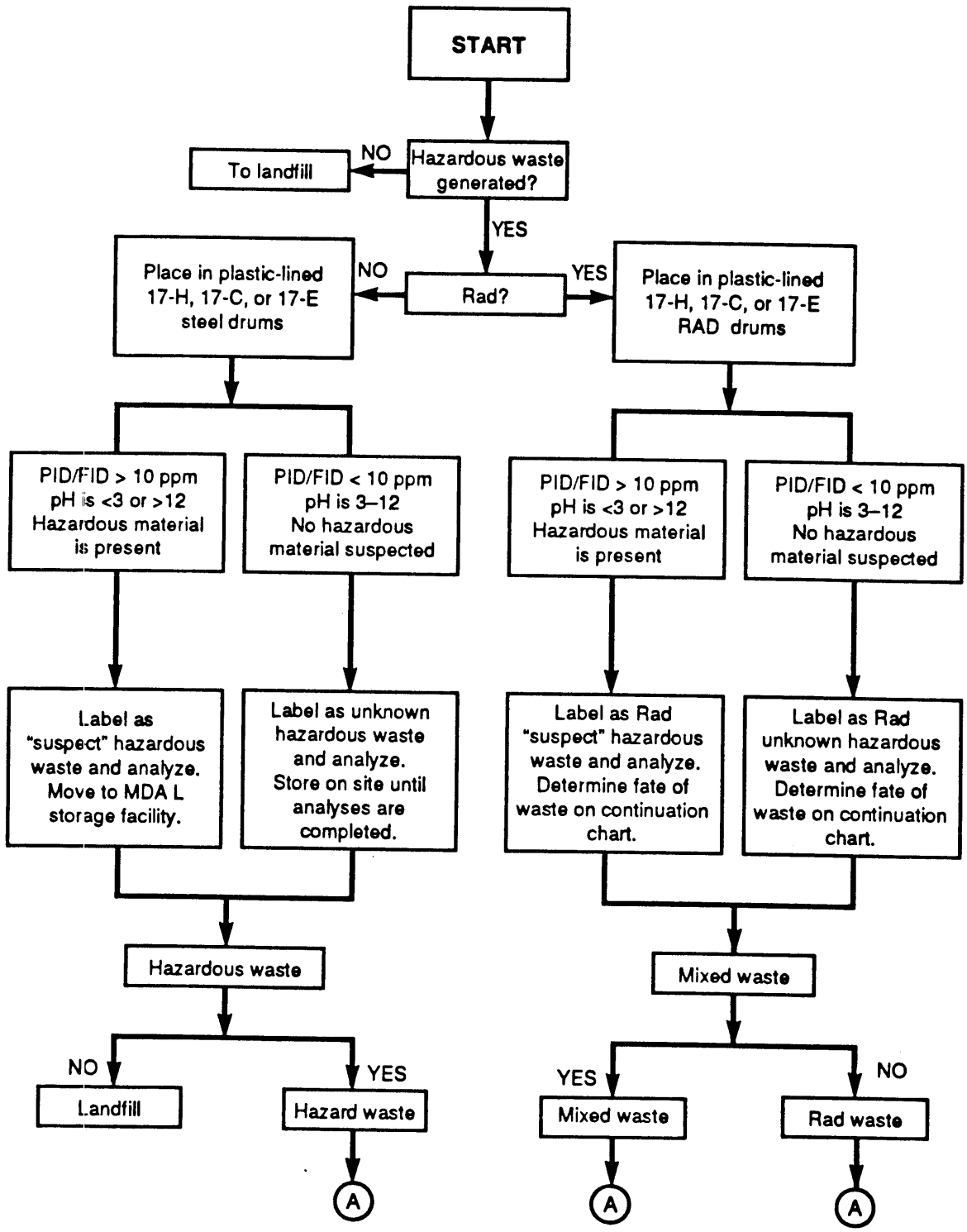


Figure B-3 Decision flow chart for the management of ER Program waste generated during the RFI.

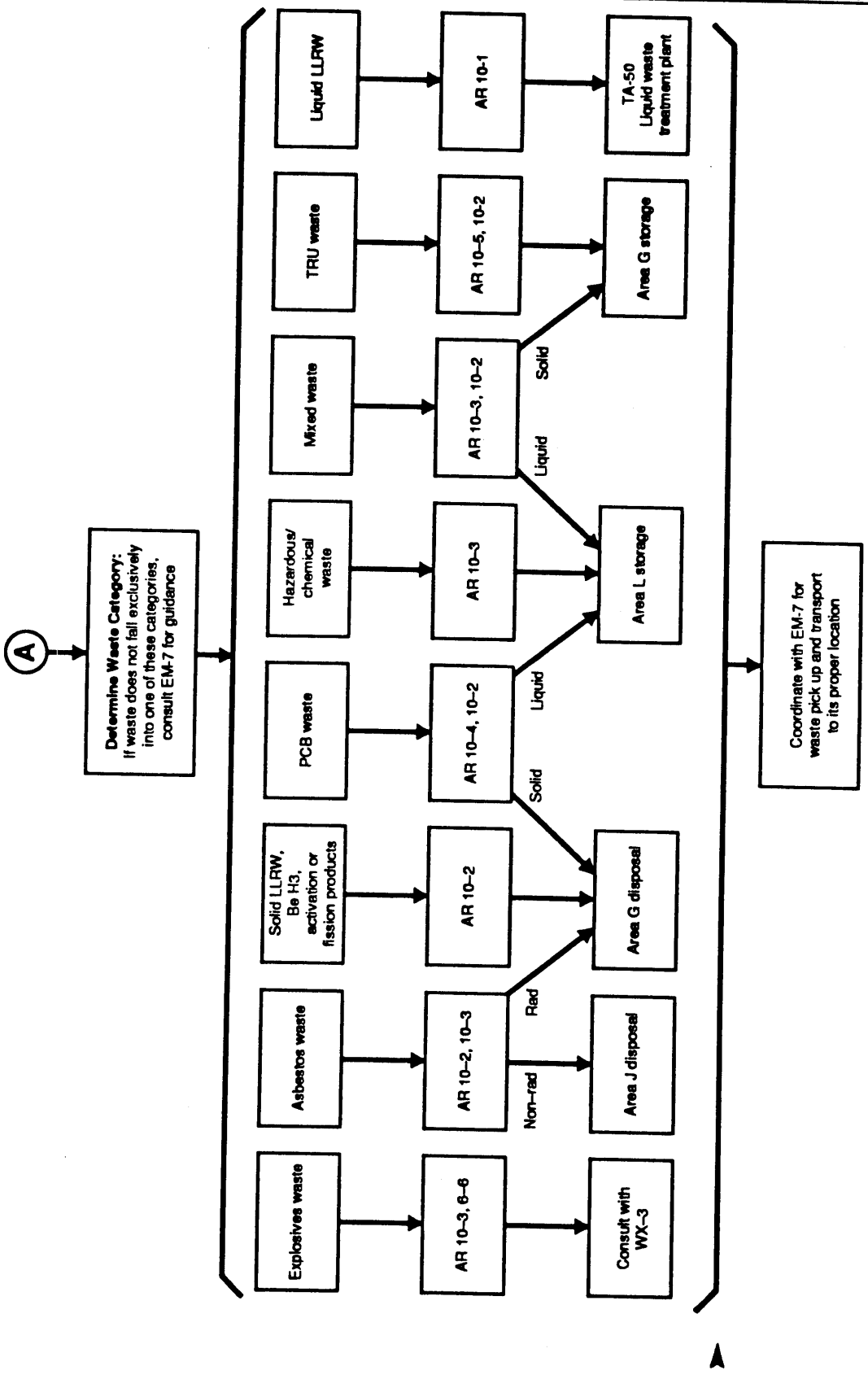


Figure B-3 (Continued) Decision flowchart for the management of ER program waste generated during the RFI.

gross beta contamination, and organic vapors. All boreholes will be monitored for combustible gases, organic vapors, and tritiated water vapor. Screening results will be recorded on the Daily Activity Logs and Sample Collection Logs.

3.6.1 Radiological Screening

Field screening of samples will be conducted for gross alpha, beta, and gamma radioactivity (refer to Figure B-2, "Site Radiological Survey Decision Flow Chart"). Screening for gross beta and gamma radioactivity will be done with a hand-held Sodium Iodide Detector (NaID) probe and rate meter. Screening for gross alpha contamination will be conducted with a hand-held Alpha Scintillation Detector (ASD) and rate meter. Field screening may be supplemented with further radiological screening in an on-site laboratory. Figure B-4, "On-Site Radiological Screening (ORS) Laboratory Sample Flow Chart," depicts the steps from sample collection through radiological screening and preparation for sample shipment. Figures B-5 through B-7 detail the decision logic in preparing radioactive, mixed, and hazardous materials for shipment.

3.6.2 Nonradioactive Screening

Organic vapor detectors will be used to screen borehole cores at the point of sample collection. Either a FID or PID will be used for this purpose. A combustible gas indicator (CGI) will be used to determine the potential for combustion or explosion of unknown atmospheres during drilling activities. The CGI will determine the level of organic vapors and gases present in an atmosphere as a percentage of the lower explosive limit (LEL) and upper explosive limit (UEL).

4.0 Passive Air Sampling

Passive air sampling will be conducted at MDAs J, L, and G. The following procedure has been modified from the standard operating procedures for Quadrel Services' EMFLUX® Soil Gas Survey System. Quadrel Services Inc. must be contacted well in advance of the start of field work to determine the optimum dates and times for sample collection.

The sampling team will be composed of two people, the Field Team Leader (FTL) and a Field Team Member (FTM). The FTL is designated "clean" and has sole responsibility for handling components which must be protected from contamination. The FTM performs all work involving contaminated surfaces. It is important that exposure of sample cartridges to ambient air be kept to a minimum.

4.1 Procedures for Collector Deployment of EMFLUX® Sampling Cartridges

1. When the FTL is wearing clean plastic gloves, the FTM carries the field kit, hoe/trowel, and sand/soil to, from, and between survey points.

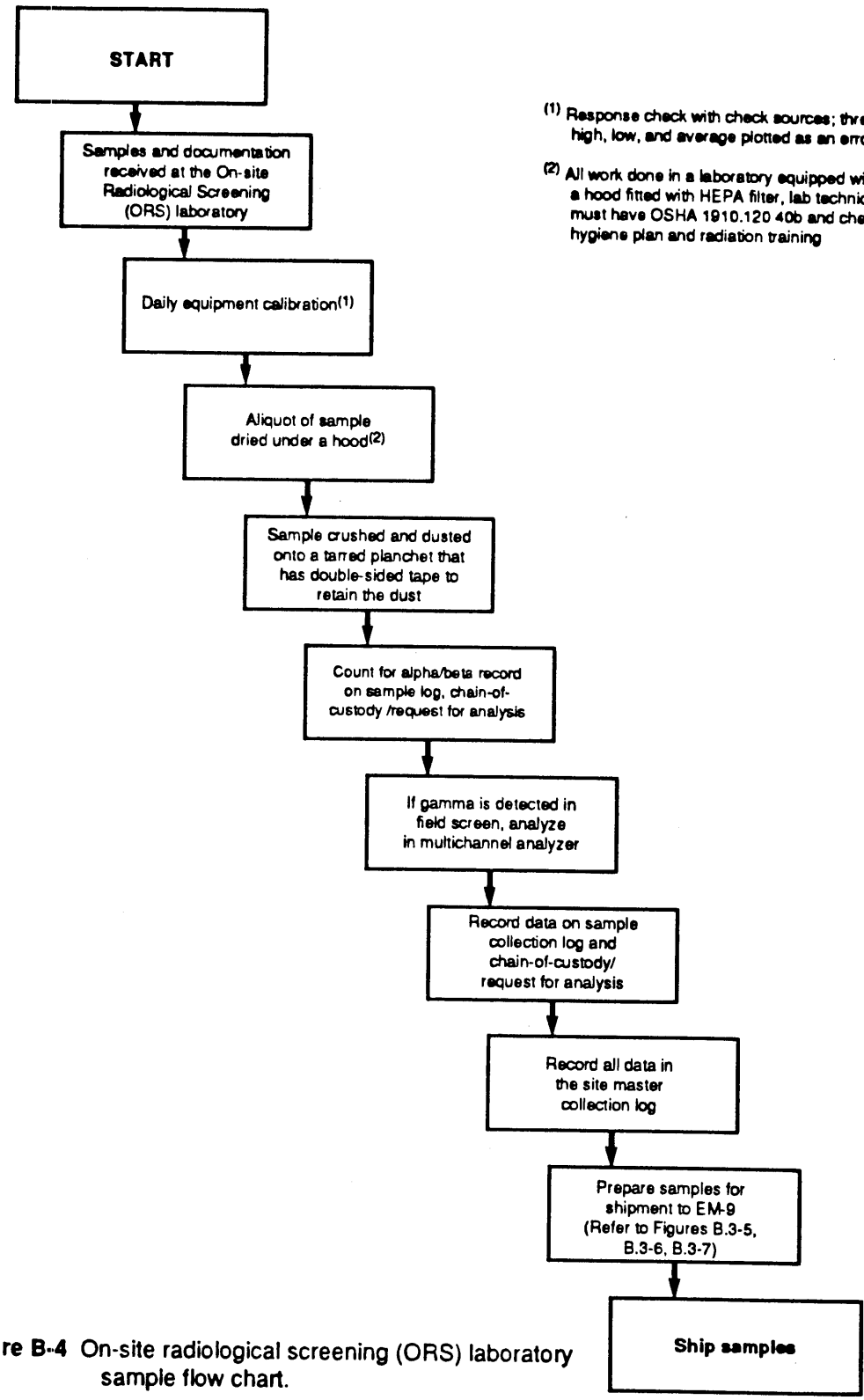
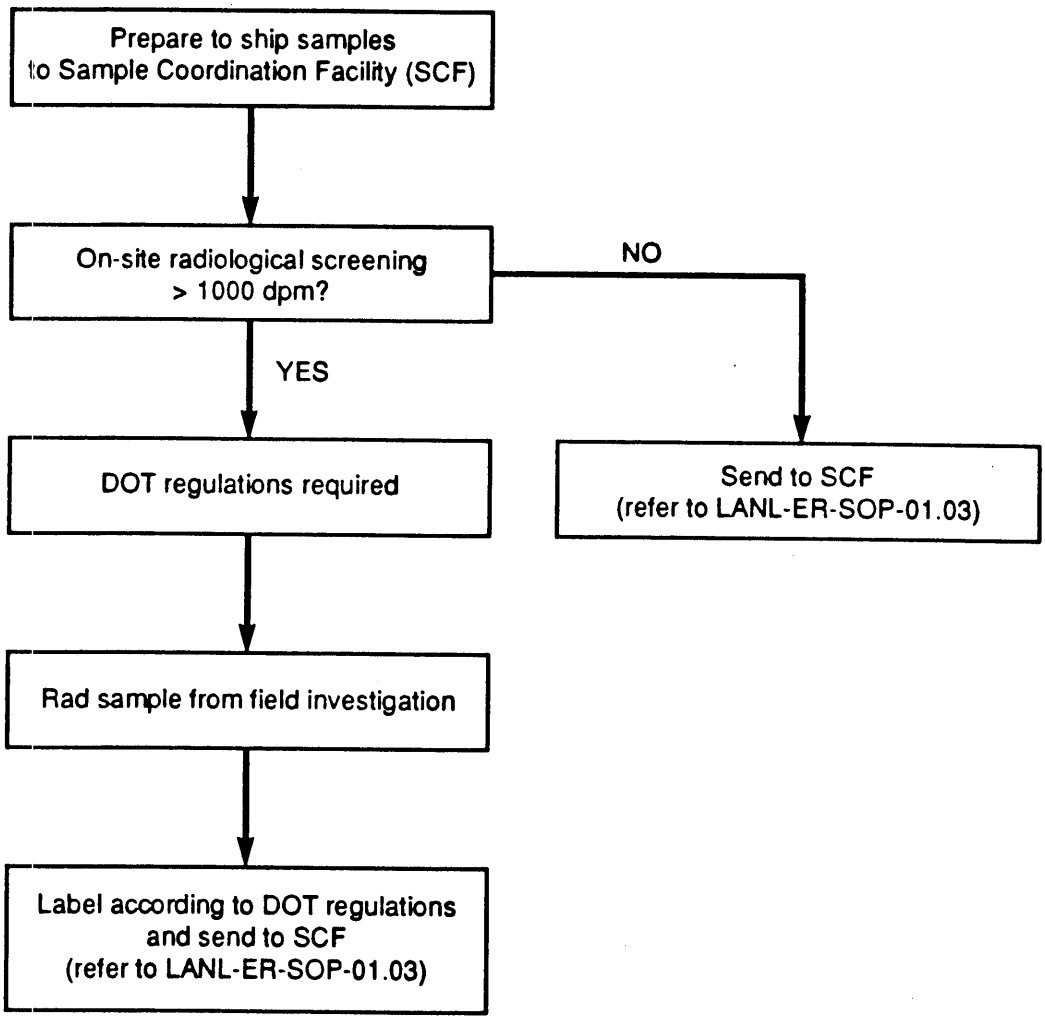
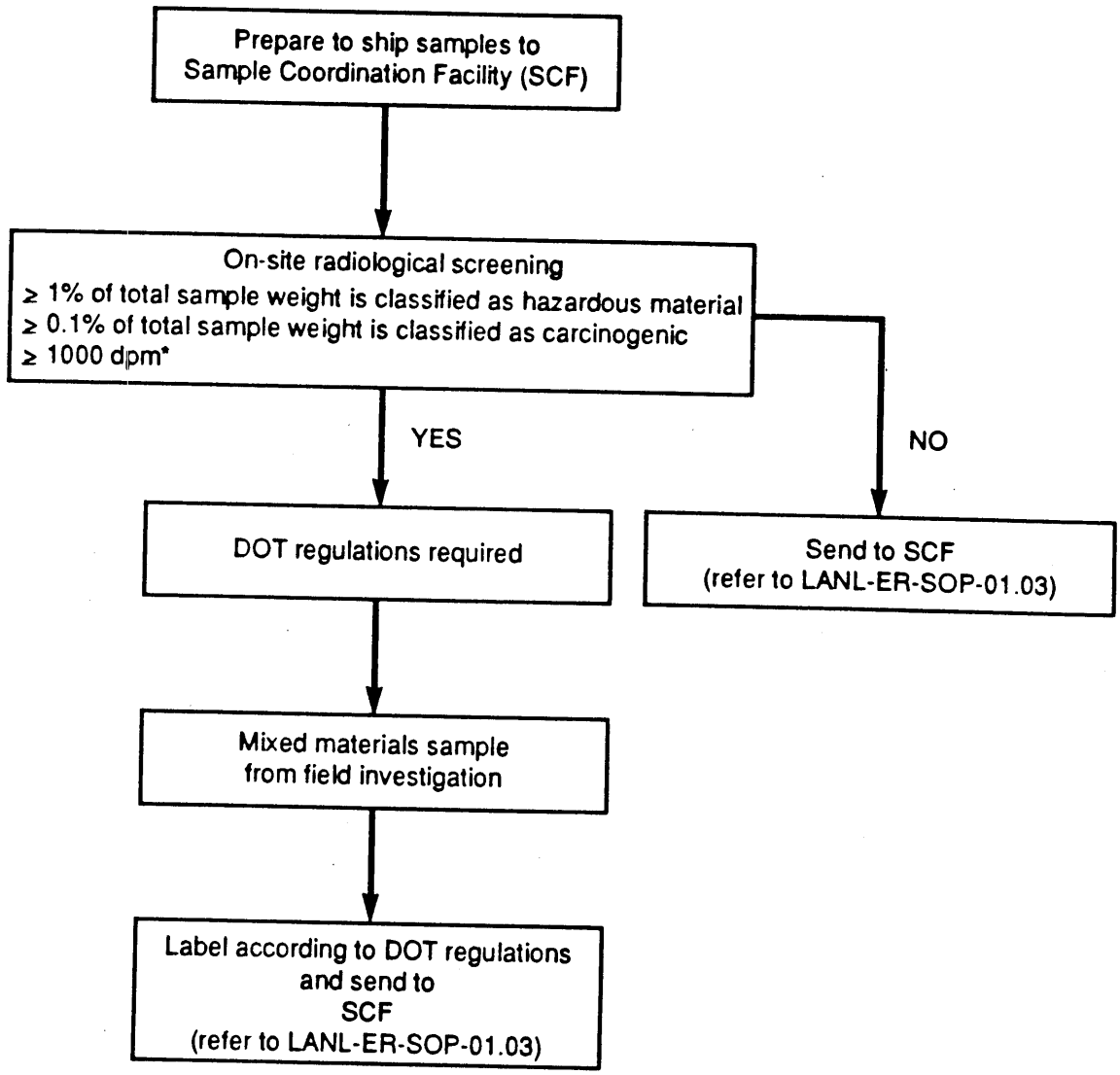


Figure B-4 On-site radiological screening (ORS) laboratory sample flow chart.



*Counted on contact of the sample container
(exclusive of 227 Ac, 210 Pb 241 Pu, 228 Ra)
See 49 CFR 173.435

Figure B-5 Radioactive material shipping decision flow chart.



*Counted on contact of the sample container (exclusive of 227 Ac, 210 Pb, 241 Pu, 228 Ra) See 49 CPR 173.435

Figure B-6 Mixed hazardous material shipping decision flow chart.

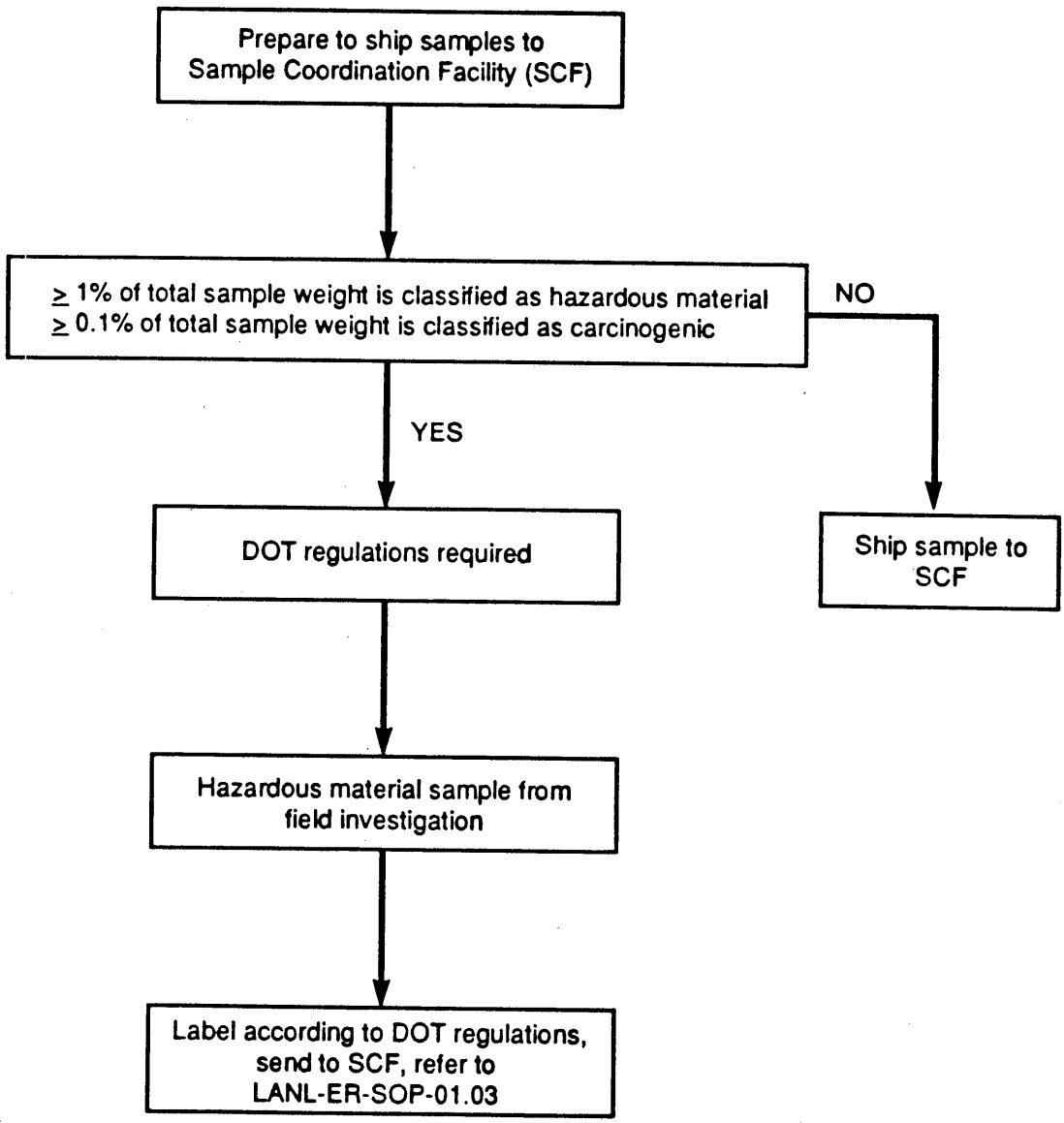


Figure B-7 Hazardous material shipping decision flow chart.

Table B.3-1

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA J.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements							Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides/PCBs	Cyanide	Tritium
Vertical Borehole	LJS-92-01	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		10.0-15.0 ft		X	X	X	X	X	X	X	X	X	X							
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X							
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X							
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X							
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X							
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X							
		50.0-55.0 ft		X	X	X	X	X	X	X	X	X	X							
		55.0-60.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip Blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment Blank														X	X	X	X	X	X	X
Field Blank														X	X	X	X	X	X	X
		60.0-65.0 ft		X	X	X	X	X	X	X	X	X	X							
		65.0-70.0 ft		X	X	X	X	X	X	X	X	X	X							
		70.0-75.0 ft		X	X	X	X	X	X	X	X	X	X							
		75.0-80.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-1 (continued)

BOREHOLE SAMPLE INTERVAL
AND ANALYSIS TABLE FOR MDA J.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements							Laboratory Analysis								
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides/PCBs	Cyanide	Tritium
Vertical Borehole	LJS-92-01	80.0-85.0 ft		X	X	X	X	X	X	X	X	X	X							
		85.0-90.0 ft		X	X	X	X	X	X	X	X	X	X							
		90.0-95.0 ft		X	X	X	X	X	X	X	X	X	X							
		95.0-100.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Trip Blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment Blank														X	X	X	X	X	X	X
Field Blank														X	X	X	X	X	X	X

X: Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-1 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA J.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening: Gross Alpha	Field Screening: Gross Beta	Field Screening: Organic Vapors	Field Screening: Gross Gamma	Field Laboratory Measurements: Low Level Alpha	Field Laboratory Measurements: Low Level Beta	Field Laboratory Measurements: Low Level Gamma	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: Gravimetric Moisture	Laboratory Analysis: Radionuclides *	Laboratory Analysis: VOCs	Laboratory Analysis: SVOCs	Laboratory Analysis: Metals	Laboratory Analysis: Pesticides/PCBs	Laboratory Analysis: Cyanide	Laboratory Analysis: Tritium
Angled Borehole	LJS-92-02	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		5.0-10.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		10.0-15.0 ft		X	X	X	X	X	X	X	X	X	X							
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X							
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X							
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X							
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		50.0-55.0 ft		X	X	X	X	X	X	X	X	X	X							
		55.0-60.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip Blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment Blank														X	X	X	X	X	X	X
Field Blank														X	X	X	X	X	X	X
		60.0-65.0 ft		X	X	X	X	X	X	X	X	X	X							
		65.0-70.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		70.0-75.0 ft		X	X	X	X	X	X	X	X	X	X							
		75.0-80.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Trip Blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment Blank														X	X	X	X	X	X	X
Field Blank														X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-2

BOREHOLE SAMPLE INTERVAL
AND ANALYSIS TABLE FOR MDA H.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening: Gross Alpha	Field Screening: Gross Beta	Field Screening: Organic Vapors	Field Screening: Gross Gamma	Field Laboratory Measurements: Low Level Alpha	Field Laboratory Measurements: Low Level Beta	Field Laboratory Measurements: Low Level Gamma	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: Gravimetric Moisture	Laboratory Analysis: Radionuclides *	Laboratory Analysis: VOCs	Laboratory Analysis: SVOCs	Laboratory Analysis: Metals	Laboratory Analysis: Pesticides/PCBs	Laboratory Analysis: Cyanide	Laboratory Analysis: Tritium
Vertical Borehole	LHS-92-01	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		5.0-10.0 ft		X	X	X	X	X	X	X	X	X	X							
		10.0-15.0 ft		X	X	X	X	X	X	X	X	X	X							
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X							
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X							
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X							
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X							
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X							
		50.0-55.0 ft		X	X	X	X	X	X	X	X	X	X							
		55.0-60.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X
		60.0-65.0 ft		X	X	X	X	X	X	X	X	X	X							
		65.0-70.0 ft		X	X	X	X	X	X	X	X	X	X							
		70.0-75.0 ft		X	X	X	X	X	X	X	X	X	X							
		75.0-80.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-2 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA H.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening: Gross Alpha	Field Screening: Gross Beta	Field Screening: Organic Vapors	Field Screening: Gross Gamma	Field Laboratory Measurements: Low Level Alpha	Field Laboratory Measurements: Low Level Beta	Field Laboratory Measurements: Low Level Gamma	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: Gravimetric Moisture	Laboratory Analysis: Radionuclides *	Laboratory Analysis: VOCs	Laboratory Analysis: SVOCs	Laboratory Analysis: Metals	Laboratory Analysis: Pesticides/PCBs	Laboratory Analysis: Cyanide	Laboratory Analysis: Tritium
Vertical Borehole	LHS-92-01	80.0-85.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		85.0-90.0 ft		X	X	X	X	X	X	X	X	X	X							
		90.0-95.0 ft		X	X	X	X	X	X	X	X	X	X							
		95.0-100.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Trip blank														C	C	C	C	C	C	C
Duplicate				X	X	X	X	X	X	X	X	X	X		X					
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X

X: Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-2 (continued)

BOREHOLE SAMPLE INTERVAL
AND ANALYSIS TABLE FOR MDA H.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements							Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides/PCBs	Cyanide	Tritium
Vertical Borehole	LHS-92-02	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		5.0-10.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		10.0-15.0 ft		X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		50.0-55.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		55.0-60.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank															X	X	X	X	X	X
Field blank															X	X	X	X	X	X
		60.0-65.0 ft		X	X	X	X	X	X	X	X	X	X	X						
		65.0-70.0 ft		X	X	X	X	X	X	X	X	X	X	X						
		70.0-75.0 ft		X	X	X	X	X	X	X	X	X	X	X						
		75.0-80.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-2 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA H.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening: Gross Alpha	Field Screening: Gross Beta	Field Screening: Organic Vapors	Field Screening: Gross Gamma	Field Laboratory Measurements: Low Level Alpha	Field Laboratory Measurements: Low Level Beta	Field Laboratory Measurements: Low Level Gamma	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: Gravimetric Moisture	Laboratory Analysis: Radionuclides *	Laboratory Analysis: VOCs	Laboratory Analysis: SVOCs	Laboratory Analysis: Metals	Laboratory Analysis: Pesticides/PCBs	Laboratory Analysis: Cyanide	Laboratory Analysis: Tritium
Vertical Borehole	LHS-92 02	80.0-85.0 ft		X	X	X	X	X	X	X	X	X	X							
		85.0-90.0 ft		X	X	X	X	X	X	X	X	X	X							
		90.0-95.0 ft		X	X	X	X	X	X	X	X	X	X							
		95.0-100.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X

X: Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-2 (continued)

BOREHOLE SAMPLE INTERVAL
AND ANALYSIS TABLE FOR MDA H.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening: Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Field Laboratory Measurements: Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Laboratory Analysis: Radionuclides *	VOCs	SVOCs	Metals	Pesticides/PCBs	Cyanide	Tritium
Vertical Borehole	LHS-92-03	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		5.0-10.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		10.0-15.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		50.0-55.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		55.0-60.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank															X	X	X	X	X	X
Field blank															X	X	X	X	X	X
		60.0-65.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		65.0-70.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		70.0-75.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		75.0-80.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-2 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA H.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements						Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides/PCBs	Cyanide	Tritium
Vertical Borehole	LHS-92-03	80.0-85.0 ft		X	X	X	X	X	X	X	X	X	X							
		85.0-90.0 ft		X	X	X	X	X	X	X	X	X	X							
		90.0-95.0 ft		X	X	X	X	X	X	X	X	X	X							
		95.0-100.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X

X: Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-2 (continued)

BOREHOLE SAMPLE INTERVAL
AND ANALYSIS TABLE FOR MDA H.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements								Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides/PCBs	Cyanide		Tritium
Vertical Borehole	LHS-92-04	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
		5.0-10.0 ft		X	X	X	X	X	X	X	X	X	X								
		10.0-15.0 ft		X	X	X	X	X	X	X	X	X	X								
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X								
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X								
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X								
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X								X
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X								
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X								
		50.0-55.0 ft		X	X	X	X	X	X	X	X	X	X								
		55.0-60.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Trip blank												X			X						
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Equipment blank														X	X	X	X	X	X		X
Field blank														X	X	X	X	X	X		X
		60.0-65.0 ft		X	X	X	X	X	X	X	X	X	X								
		65.0-70.0 ft		X	X	X	X	X	X	X	X	X	X								
		70.0-75.0 ft		X	X	X	X	X	X	X	X	X	X								
		75.0-80.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X

X : Indicates an interval where a planned screening or analysis sample will be collected.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-2 (continued)

BOREHOLE SAMPLE INTERVAL
AND ANALYSIS TABLE FOR MDA H.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening: Gross Alpha	Field Screening: Gross Beta	Field Screening: Organic Vapors	Field Screening: Gross Gamma	Field Laboratory Measurements: Low Level Alpha	Field Laboratory Measurements: Low Level Beta	Field Laboratory Measurements: Low Level Gamma	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: Gravimetric Moisture	Laboratory Analysis: Radionuclides *	Laboratory Analysis: VOCs	Laboratory Analysis: SVOCs	Laboratory Analysis: Metals	Laboratory Analysis: Pesticides/PCBs	Laboratory Analysis: Cyanide	Laboratory Analysis: Tritium
Vertical Borehole	LHS-92-04	80.0-85.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		85.0-90.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		90.0-95.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		95.0-100.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X

X: Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

				Field Screening				Field Laboratory Measurements									Laboratory Analysis							
Sample Type	Sampling Location	Interval	Sample Identification	Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides/PCBs	Cyanide	Tritium				
Vertical Borehole	LLC-92-34	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
		5.0-10.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
		10.0-15.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
		50.0-55.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
		55.0-60.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
Trip blank																								
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
Equipment blank														X	X	X	X	X	X	X				
Field blank														X	X	X	X	X	X	X				
		60.0-65.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
		65.0-70.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
		70.0-75.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
		75.0-80.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				

X : Indicates an interval where a planned screening or analysis sample will be collected.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL
AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements						Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides/PCBs	Cyanide	Tritium
Vertical Borehole	LLC-92-34	80.0-85.0 ft		X	X	X	X	X	X	X	X	X	X							
		85.0-90.0 ft		X	X	X	X	X	X	X	X	X	X							
		90.0-95.0 ft		X	X	X	X	X	X	X	X	X	X							
		95.0-100.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		100.0-105.0 ft		X	X	X	X	X	X	X	X	X	X							
		105.0-110.0 ft		X	X	X	X	X	X	X	X	X	X							
		110.0-115.0 ft		X	X	X	X	X	X	X	X	X	X							
		115.0-120.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X
		120.0-125.0 ft		X	X	X	X	X	X	X	X	X	X							
		125.0-130.0 ft		X	X	X	X	X	X	X	X	X	X							
		130.0-135.0 ft		X	X	X	X	X	X	X	X	X	X							
		135.0-140.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		140.0-145.0 ft		X	X	X	X	X	X	X	X	X	X							
		145.0-150.0 ft		X	X	X	X	X	X	X	X	X	X							
		150.0-155.0 ft		X	X	X	X	X	X	X	X	X	X							
		155.0-160.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements						Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides/PCBs	Cyanide		Tritium
Vertical Borehole	LLC-92-34	160.0-165.0 ft		X	X	X	X	X	X	X	X	X	X								
		165.0-170.0 ft		X	X	X	X	X	X	X	X	X	X								
		170.0-175.0 ft		X	X	X	X	X	X	X	X	X	X								
		175.0-180.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Trip blank															X						
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Equipment blank														X	X	X	X	X	X		X
Field blank														X	X	X	X	X	X		X
		180.0-185.0 ft		X	X	X	X	X	X	X	X	X	X								
		185.0-190.0 ft		X	X	X	X	X	X	X	X	X	X								
		190.0-195.0 ft		X	X	X	X	X	X	X	X	X	X								
		195.0-200.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
		200.0-205.0 ft		X	X	X	X	X	X	X	X	X	X								
		205.0-210.0 ft		X	X	X	X	X	X	X	X	X	X								
		210.0-215.0 ft		X	X	X	X	X	X	X	X	X	X								
		215.0-220.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
		220.0-225.0 ft		X	X	X	X	X	X	X	X	X	X								
		225.0-230.0 ft		X	X	X	X	X	X	X	X	X	X								
		230.0-235.0 ft		X	X	X	X	X	X	X	X	X	X								
		235.0-240.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Trip blank															X						
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Equipment blank														X	X	X	X	X	X		X
Field blank														X	X	X	X	X	X		X

X : Indicates an interval where a planned screening or analysis sample will be collected.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements							Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides/PCBs	Cyanide	Tritium
Vertical Borehole	LLC-92-34	240.0-245.0 ft		X	X	X	X	X	X	X	X	X	X							
		245.0-250.0 ft		X	X	X	X	X	X	X	X	X	X							
		250.0-255.0 ft		X	X	X	X	X	X	X	X	X	X							
		255.0-260.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		260.0-265.0 ft		X	X	X	X	X	X	X	X	X	X							
		265.0-270.0 ft		X	X	X	X	X	X	X	X	X	X							
		270.0-275.0 ft		X	X	X	X	X	X	X	X	X	X							
		275.0-280.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		280.0-285.0 ft		X	X	X	X	X	X	X	X	X	X							
		285.0-290.0 ft		X	X	X	X	X	X	X	X	X	X							
		290.0-295.0 ft		X	X	X	X	X	X	X	X	X	X							
		295.0-300.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X

X: Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements							Laboratory Analysis								
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture		Radionuclides *	VOCs	SVOCs	Metals	Pesticides/PCBs	Cyanide		Tritium
Vertical Borehole	LLC-92-35	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X		X
		5.0-10.0 ft		X	X	X	X	X	X	X	X	X	X									
		10.0-15.0 ft		X	X	X	X	X	X	X	X	X	X									
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X		X
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X									
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X									
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X									
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X		X
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X									
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X									
		50.0-55.0 ft		X	X	X	X	X	X	X	X	X	X									
		55.0-60.0 ft		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X		X
Trip blank																X						
Duplicate				X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X		X
Equipment blank															X	X	X	X	X	X		X
Field blank															X	X	X	X	X	X		X
		60.0-65.0 ft		X	X	X	X	X	X	X	X	X	X									
		65.0-70.0 ft		X	X	X	X	X	X	X	X	X	X									
		70.0-75.0 ft		X	X	X	X	X	X	X	X	X	X									
		75.0-80.0 ft		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X		X

X : Indicates an interval where a planned screening or analysis sample will be collected.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements							Laboratory Analysis								
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides/PCBs	Cyanide	Tritium
Vertical Borehole	LLC-92-35	80.0-85.0 ft		X	X	X	X	X	X	X	X	X	X							
		85.0-90.0 ft		X	X	X	X	X	X	X	X	X	X							
		90.0-95.0 ft		X	X	X	X	X	X	X	X	X	X							
		95.0-100.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		100.0-105.0 ft		X	X	X	X	X	X	X	X	X	X							
		105.0-110.0 ft		X	X	X	X	X	X	X	X	X	X							
		110.0-115.0 ft		X	X	X	X	X	X	X	X	X	X							
		115.0-120.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X
		120.0-125.0 ft		X	X	X	X	X	X	X	X	X	X							
		125.0-130.0 ft		X	X	X	X	X	X	X	X	X	X							
		130.0-135.0 ft		X	X	X	X	X	X	X	X	X	X							
		135.0-140.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		140.0-145.0 ft		X	X	X	X	X	X	X	X	X	X							
		145.0-150.0 ft		X	X	X	X	X	X	X	X	X	X							
		150.0-155.0 ft		X	X	X	X	X	X	X	X	X	X							
		155.0-160.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening					Laboratory Measurements							Laboratory Analysis								
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma		Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture		Radionuclides *	VOCs	SVOCs	Metals	Pesticides/PCBs	Cyanide	Tritium	
Vertical Borehole	LLC-92-35	160.0-165.0 ft		X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X		
		165.0-170.0 ft		X	X	X	X		X	X	X	X	X	X										
		170.0-175.0 ft		X	X	X	X		X	X	X	X	X	X										
		175.0-180.0 ft		X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X		X
Trip blank																	X							
Duplicate				X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X		X
Equipment blank																X	X	X	X	X	X	X		X
Field blank																X	X	X	X	X	X	X		X
		180.0-185.0 ft		X	X	X	X		X	X	X	X	X	X										
		185.0-190.0 ft		X	X	X	X		X	X	X	X	X	X										
		190.0-195.0 ft		X	X	X	X		X	X	X	X	X	X										
		195.0-200.0 ft		X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X		X
		200.0-205.0 ft		X	X	X	X		X	X	X	X	X	X										
		205.0-210.0 ft		X	X	X	X		X	X	X	X	X	X										
		210.0-215.0 ft		X	X	X	X		X	X	X	X	X	X										
		215.0-220.0 ft		X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X		X
		220.0-225.0 ft		X	X	X	X		X	X	X	X	X	X										
		225.0-230.0 ft		X	X	X	X		X	X	X	X	X	X										
		230.0-235.0 ft		X	X	X	X		X	X	X	X	X	X										
		235.0-240.0 ft		X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X		X
Trip blank																	X							
Duplicate				X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X		X
Equipment blank																X	X	X	X	X	X	X		X
Field blank																X	X	X	X	X	X	X		X

X : Indicates an interval where a planned screening or analysis sample will be collected.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

				Field Screening					Laboratory Measurements							Laboratory Analysis								
Sample Type	Sampling Location	Interval	Sample Identification	Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides/PCBs	Cyanide	Tritium
Vertical Borehole	LLC-92-35	240.0-245.0 ft		X	X	X	X	X	X	X	X	X	X							
		245.0-250.0 ft		X	X	X	X	X	X	X	X	X	X							
		250.0-255.0 ft		X	X	X	X	X	X	X	X	X	X							
		255.0-260.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		260.0-265.0 ft		X	X	X	X	X	X	X	X	X	X							
		265.0-270.0 ft		X	X	X	X	X	X	X	X	X	X							
		270.0-275.0 ft		X	X	X	X	X	X	X	X	X	X							
		275.0-280.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		280.0-285.0 ft		X	X	X	X	X	X	X	X	X	X							
		285.0-290.0 ft		X	X	X	X	X	X	X	X	X	X							
		290.0-295.0 ft		X	X	X	X	X	X	X	X	X	X							
		295.0-300.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X

X: Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening: Gross Alpha	Field Screening: Gross Beta	Field Screening: Organic Vapors	Field Screening: Gross Gamma	Field Laboratory Measurements: Low Level Alpha	Field Laboratory Measurements: Low Level Beta	Field Laboratory Measurements: Low Level Gamma	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: Gravimetric Moisture	Laboratory Analysis: Radionuclides *	Laboratory Analysis: VOCs	Laboratory Analysis: SVOCs	Laboratory Analysis: Metals	Laboratory Analysis: Pesticides/PCBs	Laboratory Analysis: Cyanide	Laboratory Analysis: Tritium
Vertical Borehole	LLC-92-36	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		5.0-10.0 ft		X	X	X	X	X	X	X	X	X	X							
		10.0-15.0 ft		X	X	X	X	X	X	X	X	X	X							
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X							
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X							
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X							
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X							
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X							
		50.0-55.0 ft		X	X	X	X	X	X	X	X	X	X							
		55.0-60.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X
		60.0-65.0 ft		X	X	X	X	X	X	X	X	X	X							
		65.0-70.0 ft		X	X	X	X	X	X	X	X	X	X							
		70.0-75.0 ft		X	X	X	X	X	X	X	X	X	X							
		75.0-80.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements							Laboratory Analysis								
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides/PCBs	Cyanide	Tritium
Vertical Borehole	LLC-92-36	80.0-85.0 ft		X	X	X	X	X	X	X	X	X	X							
		85.0-90.0 ft		X	X	X	X	X	X	X	X	X	X							
		90.0-95.0 ft		X	X	X	X	X	X	X	X	X	X							
		95.0-100.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		100.0-105.0 ft		X	X	X	X	X	X	X	X	X	X							
		105.0-110.0 ft		X	X	X	X	X	X	X	X	X	X							
		110.0-115.0 ft		X	X	X	X	X	X	X	X	X	X							
		115.0-120.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X
		120.0-125.0 ft		X	X	X	X	X	X	X	X	X	X							
		125.0-130.0 ft		X	X	X	X	X	X	X	X	X	X							
		130.0-135.0 ft		X	X	X	X	X	X	X	X	X	X							
		135.0-140.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		140.0-145.0 ft		X	X	X	X	X	X	X	X	X	X							
		145.0-150.0 ft		X	X	X	X	X	X	X	X	X	X							
		150.0-155.0 ft		X	X	X	X	X	X	X	X	X	X							
		155.0-160.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL
AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening: Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Field Laboratory Measurements: Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Laboratory Analysis: Radionuclides *	VOCs	SVOCs	Metals	Pesticides/PCBs	Cyanide	Tritium
Vertical Borehole	LLC-92-36	160.0-165.0 ft		X	X	X	X	X	X	X	X	X	X							
		165.0-170.0 ft		X	X	X	X	X	X	X	X	X	X							
		170.0-175.0 ft		X	X	X	X	X	X	X	X	X	X							
		175.0-180.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X
		180.0-185.0 ft		X	X	X	X	X	X	X	X	X	X							
		185.0-190.0 ft		X	X	X	X	X	X	X	X	X	X							
		190.0-195.0 ft		X	X	X	X	X	X	X	X	X	X							
		195.0-200.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		200.0-205.0 ft		X	X	X	X	X	X	X	X	X	X							
		205.0-210.0 ft		X	X	X	X	X	X	X	X	X	X							
		210.0-215.0 ft		X	X	X	X	X	X	X	X	X	X							
		215.0-220.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		220.0-225.0 ft		X	X	X	X	X	X	X	X	X	X							
		225.0-230.0 ft		X	X	X	X	X	X	X	X	X	X							
		230.0-235.0 ft		X	X	X	X	X	X	X	X	X	X							
		235.0-240.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements							Laboratory Analysis								
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides/PCBs	Cyanide	Tritium
Vertical Borehole	LLC-92-36	240.0-245.0 ft		X	X	X	X	X	X	X	X	X	X							
		245.0-250.0 ft		X	X	X	X	X	X	X	X	X	X							
		250.0-255.0 ft		X	X	X	X	X	X	X	X	X	X							
		255.0-260.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		260.0-265.0 ft		X	X	X	X	X	X	X	X	X	X							
		265.0-270.0 ft		X	X	X	X	X	X	X	X	X	X							
		270.0-275.0 ft		X	X	X	X	X	X	X	X	X	X							
		275.0-280.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		280.0-285.0 ft		X	X	X	X	X	X	X	X	X	X							
		285.0-290.0 ft		X	X	X	X	X	X	X	X	X	X							
		290.0-295.0 ft		X	X	X	X	X	X	X	X	X	X							
		295.0-300.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X

X: Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

Table B.3-3

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L

				Field Screening				Field Laboratory Measurements							Laboratory Analysis						
Sample Type	Sampling Location	Interval	Sample Identification	Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides /PCBs	Cyanide	Tritium
Angled Borehole	LLS-92-01	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		5.0-10.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		10.0-15.0 ft		X	X	X	X	X	X	X	X	X	X							
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X							
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X							
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X							
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening					Field Laboratory Measurements							Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma		Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture		Radionuclides *	VOCs	SVOCs	Metals	Pesticides /PCBs	Cyanide	Tritium	
Angled Borehole	LLS-92-02	0.0-5.0 ft		X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X	
		5.0-10.0 ft		X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X	
		10.0-15.0 ft		X	X	X	X		X	X	X	X	X	X									
		15.0-20.0 ft		X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X	
		20.0-25.0 ft		X	X	X	X		X	X	X	X	X	X									
		25.0-30.0 ft		X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X	
		30.0-35.0 ft		X	X	X	X		X	X	X	X	X	X									
		35.0-40.0 ft		X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X	
		40.0-45.0 ft		X	X	X	X		X	X	X	X	X	X									
		45.0-50.0 ft		X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X	
				C	C	C	C		C	C	C	C	C	C		C	C	C	C	C	C	C	
				C	C	C	C		C	C	C	C	C	C		C	C	C	C	C	C	C	
Trip blank																	X						
Duplicate				X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X	
Equipment blank																X	X	X	X	X	X	X	
Field blank																X	X	X	X	X	X	X	

X : Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements						Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides/PCBs	Cyanide	Tritium
Angled Borehole	LLS-92-11	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		5.0-10.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		10.0-15.0 ft		X	X	X	X	X	X	X	X	X	X							
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X							
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X							
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X							
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening					Field Laboratory Measurements						Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma		Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides /PCBs	Cyanide	Tritium
Angled Borehole	LLS-92-12	0.0-5.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
		5.0-10.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
		10.0-15.0 ft		X	X	X	X		X	X	X	X	X	X							
		15.0-20.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
		20.0-25.0 ft		X	X	X	X		X	X	X	X	X	X							
		25.0-30.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
		30.0-35.0 ft		X	X	X	X		X	X	X	X	X	X							
		35.0-40.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
		40.0-45.0 ft		X	X	X	X		X	X	X	X	X	X							
		45.0-50.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
				C	C	C	C		C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C		C	C	C	C	C	C	C	C	C	C	C	C	C
Trip blank																X					
Duplicate				X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank															X	X	X	X	X	X	X
Field blank															X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL
AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening: Gross Alpha	Field Screening: Gross Beta	Field Screening: Organic Vapors	Field Screening: Gross Gamma	Field Laboratory Measurements: Low Level Alpha	Field Laboratory Measurements: Low Level Beta	Field Laboratory Measurements: Low Level Gamma	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: Gravimetric Moisture	Laboratory Analysis: Radionuclides *	Laboratory Analysis: VOCs	Laboratory Analysis: SVOCs	Laboratory Analysis: Metals	Laboratory Analysis: Pesticides /PCBs	Laboratory Analysis: Cyanide	Laboratory Analysis: Tritium
Angled Borehole	LLS-92-13	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		5.0-10.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		10.0-15.0 ft		X	X	X	X	X	X	X	X	X	X							
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X							
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X							
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X							
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements							Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides /PCBs	Cyanide	Tritium
Vertical Borehole	LLS-92-03	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		5.0-10.0 ft		X	X	X	X	X	X	X	X	X	X							
		10.0-15.0 ft		X	X	X	X	X	X	X	X	X	X							
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X							
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X							
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X							
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X							
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X							
		50.0-55.0 ft		X	X	X	X	X	X	X	X	X	X							
		55.0-60.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X
		60.0-65.0 ft		X	X	X	X	X	X	X	X	X	X							
		65.0-70.0 ft		X	X	X	X	X	X	X	X	X	X							
		70.0-75.0 ft		X	X	X	X	X	X	X	X	X	X							
		75.0-80.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening					Field Laboratory Measurements							Laboratory Analysis								
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma		Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture		Radionuclides *	VOCs	SVOCs	Metals	Pesticides /PCBs	Cyanide		Tritium
Vertical Borehole	LLS-92-03	80.0-85.0 ft		X	X	X	X		X	X	X	X	X	X										
		85.0-90.0 ft		X	X	X	X		X	X	X	X	X	X										
		90.0-95.0 ft		X	X	X	X		X	X	X	X	X	X										
		95.0-100.0 ft		X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X		X	
				C	C	C	C		C	C	C	C	C	C		C	C	C	C	C	C		C	
				C	C	C	C		C	C	C	C	C	C		C	C	C	C	C	C		C	
Trip blank																	X							
Duplicate				X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X		X	
Equipment blank																X	X	X	X	X	X		X	
Field blank																X	X	X	X	X	X		X	

X: Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements							Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides /PCBs	Cyanide	Tritium
Vertical Borehole	LLS-92-04	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		5.0-10.0 ft		X	X	X	X	X	X	X	X	X	X							
		10.0-15.0 ft		X	X	X	X	X	X	X	X	X	X							
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X							
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X							
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X							
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X							
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X							
		50.0-55.0 ft		X	X	X	X	X	X	X	X	X	X							
		55.0-60.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X
		60.0-65.0 ft		X	X	X	X	X	X	X	X	X	X							
		65.0-70.0 ft		X	X	X	X	X	X	X	X	X	X							
		70.0-75.0 ft		X	X	X	X	X	X	X	X	X	X							
		75.0-80.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening: Gross Alpha	Field Screening: Gross Beta	Field Screening: Organic Vapors	Field Screening: Gross Gamma	Field Laboratory Measurements: Low Level Alpha	Field Laboratory Measurements: Low Level Beta	Field Laboratory Measurements: Low Level Gamma	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: Gravimetric Moisture	Laboratory Analysis: Radionuclides *	Laboratory Analysis: VOCs	Laboratory Analysis: SVOCs	Laboratory Analysis: Metals	Laboratory Analysis: Pesticides /PCBs	Laboratory Analysis: Cyanide	Laboratory Analysis: Tritium
Vertical Borehole	LLS-92-04	80.0-85.0 ft		X	X	X	X	X	X	X	X	X	X							
		85.0-90.0 ft		X	X	X	X	X	X	X	X	X	X							
		90.0-95.0 ft		X	X	X	X	X	X	X	X	X	X							
		95.0-100.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X

X: Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening					Field Laboratory Measurements							Laboratory Analysis								
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides/PCBs	Cyanide	Tritium
Vertical Borehole	LLS-92-05	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		5.0-10.0 ft		X	X	X	X	X	X	X	X	X	X							
		10.0-15.0 ft		X	X	X	X	X	X	X	X	X	X							
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X							
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X							
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X							
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X							
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X							
		50.0-55.0 ft		X	X	X	X	X	X	X	X	X	X							
		55.0-60.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X
		60.0-65.0 ft		X	X	X	X	X	X	X	X	X	X							
		65.0-70.0 ft		X	X	X	X	X	X	X	X	X	X							
		70.0-75.0 ft		X	X	X	X	X	X	X	X	X	X							
		75.0-80.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements								Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides /PCBs	Cyanide	Tritium			
Vertical Borehole	LLS-92-05	80.0-85.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
		85.0-90.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
		90.0-95.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
		95.0-100.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
				C	C	C	C	C	C	C	C	C		C	C	C	C	C	C				
				C	C	C	C	C	C	C	C	C		C	C	C	C	C	C				
Trip blank															X								
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Equipment blank														X	X	X	X	X	X	X			
Field blank														X	X	X	X	X	X	X			

X: Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements						Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides /PCBs	Cyanide	Tritium
Vertical Borehole	LLS-92-06	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		5.0-10.0 ft		X	X	X	X	X	X	X	X	X	X							
		10.0-15.0 ft		X	X	X	X	X	X	X	X	X	X							
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X							
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X							
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X							
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X							
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X							
		50.0-55.0 ft		X	X	X	X	X	X	X	X	X	X							
		55.0-60.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X
		60.0-65.0 ft		X	X	X	X	X	X	X	X	X	X							
		65.0-70.0 ft		X	X	X	X	X	X	X	X	X	X							
		70.0-75.0 ft		X	X	X	X	X	X	X	X	X	X							
		75.0-80.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL
AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements								Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides /PCBs	Cyanide	Tritium
Vertical Borehole	LLS-92-06	80.0-85.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		85.0-90.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		90.0-95.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		95.0-100.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X

X: Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening					Field Laboratory Measurements							Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides /PCBs	Cyanide	Tritium
Vertical Borehole	LLS-92-07	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		5.0-10.0 ft		X	X	X	X	X	X	X	X	X	X							
		10.0-15.0 ft		X	X	X	X	X	X	X	X	X	X							
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X							
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X							
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X							
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X							
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X							
		50.0-55.0 ft		X	X	X	X	X	X	X	X	X	X							
		55.0-60.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X
		60.0-65.0 ft		X	X	X	X	X	X	X	X	X	X							
		65.0-70.0 ft		X	X	X	X	X	X	X	X	X	X							
		70.0-75.0 ft		X	X	X	X	X	X	X	X	X	X							
		75.0-80.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL
AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements								Laboratory Analysis							
				Gross Alpha		Gross Beta		Organic Vapors		Gross Gamma		Low Level Alpha		Low Level Beta		Low Level Gamma		Tritium		Volatile Organics		Gravimetric Moisture	
Vertical Borehole	LLS-92-07	80.0-85.0 ft		X		X		X		X		X		X		X		X		X		X	
		85.0-90.0 ft		X		X		X		X		X		X		X		X		X		X	
		90.0 95.0 ft		X		X		X		X		X		X		X		X		X		X	
		95.0-100.0 ft		X		X		X		X		X		X		X		X		X		X	
				C		C		C		C		C		C		C		C		C		C	
				C		C		C		C		C		C		C		C		C		C	
				C		C		C		C		C		C		C		C		C		C	
Trip blank																				X			
Duplicate				X		X		X		X		X		X		X		X		X		X	
Equipment blank																				X		X	
Field blank																				X		X	

Sample Type	Sampling Location	Interval	Sample Identification	Laboratory Analysis							
				Radionuclides *		VOCs		SVOCs		Metals		Pesticides /PCBs		Cyanide		Tritium	
Vertical Borehole	LLS-92-07	80.0-85.0 ft		X		X		X		X		X		X		X	
		85.0-90.0 ft		X		X		X		X		X		X		X	
		90.0 95.0 ft		X		X		X		X		X		X		X	
		95.0-100.0 ft		X		X		X		X		X		X		X	
				C		C		C		C		C		C		C	
				C		C		C		C		C		C		C	
				C		C		C		C		C		C		C	
Trip blank						X											
Duplicate				X		X		X		X		X		X		X	
Equipment blank						X		X		X		X		X			
Field blank						X		X		X		X		X			

X: Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening: Gross Alpha	Field Screening: Gross Beta	Field Screening: Organic Vapors	Field Screening: Gross Gamma	Field Laboratory Measurements: Low Level Alpha	Field Laboratory Measurements: Low Level Beta	Field Laboratory Measurements: Low Level Gamma	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: Gravimetric Moisture	Laboratory Analysis: Radionuclides *	Laboratory Analysis: VOCs	Laboratory Analysis: SVOCs	Laboratory Analysis: Metals	Laboratory Analysis: Pesticides /PCBs	Laboratory Analysis: Cyanide	Laboratory Analysis: Tritium
Vertical Borehole	LLS-92-08	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		5.0-10.0 ft		X	X	X	X	X	X	X	X	X	X							
		10.0-15.0 ft		X	X	X	X	X	X	X	X	X	X							
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X							
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X							
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X							
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X							
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X							
		50.0-55.0 ft		X	X	X	X	X	X	X	X	X	X							
		55.0-60.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X
		60.0-65.0 ft		X	X	X	X	X	X	X	X	X	X							
		65.0-70.0 ft		X	X	X	X	X	X	X	X	X	X							
		70.0-75.0 ft		X	X	X	X	X	X	X	X	X	X							
		75.0-80.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening: Gross Alpha	Field Screening: Gross Beta	Field Screening: Organic Vapors	Field Screening: Gross Gamma	Field Laboratory Measurements: Low Level Alpha	Field Laboratory Measurements: Low Level Beta	Field Laboratory Measurements: Low Level Gamma	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: Gravimetric Moisture	Laboratory Analysis: Radionuclides *	Laboratory Analysis: VOCs	Laboratory Analysis: SVOCs	Laboratory Analysis: Metals	Laboratory Analysis: Pesticides /PCBs	Laboratory Analysis: Cyanide	Laboratory Analysis: Tritium
Vertical Borehole	LLS-92-08	80.0-85.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		85.0-90.0 ft		X	X	X	X	X	X	X	X	X	X							
		90.0-95.0 ft		X	X	X	X	X	X	X	X	X	X							
		95.0-100.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X

X: Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL
AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening					Field Laboratory Measurements							Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides /PCBs	Cyanide	Tritium
Vertical Borehole	LLS-92-09	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		5.0-10.0 ft		X	X	X	X	X	X	X	X	X	X							
		10.0-15.0 ft		X	X	X	X	X	X	X	X	X	X							
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X							
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X							
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X							
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X							
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X							
		50.0-55.0 ft		X	X	X	X	X	X	X	X	X	X							
		55.0-60.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X
		60.0-65.0 ft		X	X	X	X	X	X	X	X	X	X							
		65.0-70.0 ft		X	X	X	X	X	X	X	X	X	X							
		70.0-75.0 ft		X	X	X	X	X	X	X	X	X	X							
		75.0-80.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements						Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides *	VOCs	SVOCs	Metals	Pesticides/PCBs	Cyanide	Tritium
Vertical Borehole	LLS-92-09	80.0-85.0 ft		X	X	X	X	X	X	X	X	X	X							
		85.0-90.0 ft		X	X	X	X	X	X	X	X	X	X							
		90.0-95.0 ft		X	X	X	X	X	X	X	X	X	X							
		95.0-100.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X

X: Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening					Field Laboratory Measurements							Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma		Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture		Radionuclides *	VOCs	SVOCs	Metals	Pesticides /PCBs	Cyanide	Tritium	
Vertical Borehole	LLS-92-10	0.0-5.0 ft		X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X	
		5.0-10.0 ft		X	X	X	X		X	X	X	X	X	X									
		10.0-15.0 ft		X	X	X	X		X	X	X	X	X	X									
		15.0-20.0 ft		X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X	
		20.0-25.0 ft		X	X	X	X		X	X	X	X	X	X									
		25.0-30.0 ft		X	X	X	X		X	X	X	X	X	X									
		30.0-35.0 ft		X	X	X	X		X	X	X	X	X	X									
		35.0-40.0 ft		X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X	
		40.0-45.0 ft		X	X	X	X		X	X	X	X	X	X									
		45.0-50.0 ft		X	X	X	X		X	X	X	X	X	X									
		50.0-55.0 ft		X	X	X	X		X	X	X	X	X	X									
		55.0-60.0 ft		X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X	
Trip blank																	X						
Duplicate				X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X	
Equipment blank																X	X	X	X	X	X	X	
Field blank																X	X	X	X	X	X	X	
		60.0-65.0 ft		X	X	X	X		X	X	X	X	X	X									
		65.0-70.0 ft		X	X	X	X		X	X	X	X	X	X									
		70.0-75.0 ft		X	X	X	X		X	X	X	X	X	X									
		75.0-80.0 ft		X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X	

X : Indicates an interval where a planned screening or analysis sample will be collected.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-3 (continued)

BOREHOLE SAMPLE INTERVAL
AND ANALYSIS TABLE FOR MDA L.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening: Gross Alpha	Field Screening: Gross Beta	Field Screening: Organic Vapors	Field Laboratory Measurements: Gross Gamma	Field Laboratory Measurements: Low Level Alpha	Field Laboratory Measurements: Low Level Beta	Field Laboratory Measurements: Low Level Gamma	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: Gravimetric Moisture	Laboratory Analysis: Radionuclides *	Laboratory Analysis: VOCs	Laboratory Analysis: SVOCs	Laboratory Analysis: Metals	Laboratory Analysis: Pesticides /PCBs	Laboratory Analysis: Cyanide	Laboratory Analysis: Tritium
Vertical Borehole	LLS-92-10	80.0-85.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		85.0-90.0 ft		X	X	X	X	X	X	X	X	X	X	C	C	C	C	C	C	C
		90.0-95.0 ft		X	X	X	X	X	X	X	X	X	X	C	C	C	C	C	C	C
		95.0-100.0 ft		X	X	X	X	X	X	X	X	X	X	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C							
				C	C	C	C	C	C	C	C	C	C							
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X

X: Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

* Gross alpha, gross beta, and gamma spectroscopy only.

Table B.3-4

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA G.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements						Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides	VOCs	SVOCs	Metals	Pesticides/PCB	Cyanide	Tritium
Vertical Borehole	LGC-92-37	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		5.0-10.0 ft		X	X	X	X	X	X	X	X	X	X							
		10.0-15.0 ft		X	X	X	X	X	X	X	X	X	X							
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X							
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X							
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X							
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X							
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X							
		50.0-55.0 ft		X	X	X	X	X	X	X	X	X	X							
		55.0-60.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X
		60.0-65.0 ft		X	X	X	X	X	X	X	X	X	X							
		65.0-70.0 ft		X	X	X	X	X	X	X	X	X	X							
		70.0-75.0 ft		X	X	X	X	X	X	X	X	X	X							
		75.0-80.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

Table B.3-4 (continued)

BOREHOLE SAMPLE INTERVAL
AND ANALYSIS TABLE FOR MDA G.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements							Laboratory Analysis						
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides	VOCs	SVOCs	Metals	Pesticides/PCB	Cyanide	Tritium
Vertical Borehole	LGC-92-37	80.0-85.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		85.0-90.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		90.0-95.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		95.0-100.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X

X: Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan

Table B.3-4 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA G.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements							Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture		Radionuclides	VOCs	SVOCs	Metals	Pesticides/PCB	Cyanide	Tritium
Vertical Borehole	LGC-92-38	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
		5.0-10.0 ft		X	X	X	X	X	X	X	X	X	X								
		10.0-15.0 ft		X	X	X	X	X	X	X	X	X	X								
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X								
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X								
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X								
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X								
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X								
		50.0-55.0 ft		X	X	X	X	X	X	X	X	X	X								
		55.0-60.0 ft		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
Trip blank																X					
Duplicate				X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
Equipment blank															X	X	X	X	X	X	X
Field blank															X	X	X	X	X	X	X
		60.0-65.0 ft		X	X	X	X	X	X	X	X	X	X								
		65.0-70.0 ft		X	X	X	X	X	X	X	X	X	X								
		70.0-75.0 ft		X	X	X	X	X	X	X	X	X	X								
		75.0-80.0 ft		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

Table B.3-4 (continued)

BOREHOLE SAMPLE INTERVAL
AND ANALYSIS TABLE FOR MDA G.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements								Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides	VOCs	SVOCs	Metals	Pesticides/PCB	Cyanide	Tritium
Vertical Borehole	LGC-92-38	80.0-85.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		85.0-90.0 ft		X	X	X	X	X	X	X	X	X	X	C	C	C	C	C	C	C
		90.0-95.0 ft		X	X	X	X	X	X	X	X	X	X	C	C	C	C	C	C	C
		95.0-100.0 ft		X	X	X	X	X	X	X	X	X	X	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X

X: Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan

Table B.3-4 (continued)

BOREHOLE SAMPLE INTERVAL AND ANALYSIS TABLE FOR MDA G.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements							Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides	VOCs	SVOCs	Metals	Pesticides/PCB	Cyanide	Tritium
Vertical Borehole	LGC-92-39	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		5.0-10.0 ft		X	X	X	X	X	X	X	X	X	X							
		10.0-15.0 ft		X	X	X	X	X	X	X	X	X	X							
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X							
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X							
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X							
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X							
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X							
		50.0-55.0 ft		X	X	X	X	X	X	X	X	X	X							
		55.0-60.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X
		60.0-65.0 ft		X	X	X	X	X	X	X	X	X	X							
		65.0-70.0 ft		X	X	X	X	X	X	X	X	X	X							
		70.0-75.0 ft		X	X	X	X	X	X	X	X	X	X							
		75.0-80.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

Table B.3-4 (continued)

BOREHOLE SAMPLE INTERVAL
AND ANALYSIS TABLE FOR MDA G.

				Field Screening				Field Laboratory Measurements							Laboratory Analysis							
Sample Type	Sampling Location	Interval	Sample Identification	Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides	VOCs	SVOCs	Metals	Pesticides/PCB	Cyanide	Tritium		
Vertical Borehole	LGC-92-39	80.0-85.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
		85.0-90.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
		90.0-95.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
		95.0-100.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C		
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C		
Trip blank															X					X		
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Equipment blank																						
Field blank																						

X: Indicates an interval where a planned screening or analysis sample will be collected.
C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan

Table B.3-4 (continued)

BOREHOLE SAMPLE INTERVAL
AND ANALYSIS TABLE FOR MDA G.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements						Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides	VOCs	SVOCs	Metals	Pesticides/PCB	Cyanide	Tritium
Vertical Borehole	LGC-92-40	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		5.0-10.0 ft		X	X	X	X	X	X	X	X	X	X							
		10.0-15.0 ft		X	X	X	X	X	X	X	X	X	X							
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X							
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X							
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X							
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X							
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X							
		50.0-55.0 ft		X	X	X	X	X	X	X	X	X	X							
		55.0-60.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X
		60.0-65.0 ft		X	X	X	X	X	X	X	X	X	X							
		65.0-70.0 ft		X	X	X	X	X	X	X	X	X	X							
		70.0-75.0 ft		X	X	X	X	X	X	X	X	X	X							
		75.0-80.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

Table B.3-4 (continued)

BOREHOLE SAMPLE INTERVAL
AND ANALYSIS TABLE FOR MDA G.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements								Laboratory Analysis							
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides	VOCs	SVOCs	Metals	Pesticides/PCB	Cyanide	Tritium
Vertical Borehole	LGC-92-40	80.0-85.0 ft		X	X	X	X	X	X	X	X	X	X							
		85.0-90.0 ft		X	X	X	X	X	X	X	X	X	X							
		90.0-95.0 ft		X	X	X	X	X	X	X	X	X	X							
		95.0-100.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X

X: Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

Table B.3-4 (continued)

BOREHOLE SAMPLE INTERVAL
AND ANALYSIS TABLE FOR MDA G.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening					Field Laboratory Measurements							Laboratory Analysis								
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides	VOCs	SVOCs	Metals	Pesticides/PCB	Cyanide	Tritium
Vertical Borehole	LGC-92-41	0.0-5.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		5.0-10.0 ft		X	X	X	X	X	X	X	X	X	X							
		10.0-15.0 ft		X	X	X	X	X	X	X	X	X	X							
		15.0-20.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		20.0-25.0 ft		X	X	X	X	X	X	X	X	X	X							
		25.0-30.0 ft		X	X	X	X	X	X	X	X	X	X							
		30.0-35.0 ft		X	X	X	X	X	X	X	X	X	X							
		35.0-40.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		40.0-45.0 ft		X	X	X	X	X	X	X	X	X	X							
		45.0-50.0 ft		X	X	X	X	X	X	X	X	X	X							
		50.0-55.0 ft		X	X	X	X	X	X	X	X	X	X							
		55.0-60.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip blank															X					
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment blank														X	X	X	X	X	X	X
Field blank														X	X	X	X	X	X	X
		60.0-65.0 ft		X	X	X	X	X	X	X	X	X	X							
		65.0-70.0 ft		X	X	X	X	X	X	X	X	X	X							
		70.0-75.0 ft		X	X	X	X	X	X	X	X	X	X							
		75.0-80.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X : Indicates an interval where a planned screening or analysis sample will be collected.

Table B.3-4 (continued)

BOREHOLE SAMPLE INTERVAL
AND ANALYSIS TABLE FOR MDA G.

Sample Type	Sampling Location	Interval	Sample Identification	Field Screening				Field Laboratory Measurements							Laboratory Analysis								
				Gross Alpha	Gross Beta	Organic Vapors	Gross Gamma	Low Level Alpha	Low Level Beta	Low Level Gamma	Tritium	Volatile Organics	Gravimetric Moisture	Radionuclides	VOCs	SVOCs	Metals	Pesticides/PCB	Cyanide		Tritium		
Vertical Borehole	LGC-92-41	80.0-85.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		
		85.0-90.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		
		90.0-95.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		
		95.0-100.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C		C		
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C		C		
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C		C		
Trip blank															X								
Duplicate				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		
Equipment blank														X	X	X	X	X	X		X		
Field blank														X	X	X	X	X	X		X		

X: Indicates an interval where a planned screening or analysis sample will be collected.

C: Indicates a contingency sample. Contingency samples will be collected when contamination extends below the nominal depth of the borehole. Contingency samples may be used in any portion of the plan.

2. At each sampling point, the FTM prepares the site, clearing away vegetation, debris, etc., and opening the field kit.

3. The FTL dons plastic gloves, being careful to avoid touching surfaces which will come in contact with EMFLUX® components.

4. The FTM removes the collection shell from its protective bag (touching only the outside of the shell) and scores the ground to guide sample placement.

5. The FTM opens the cartridge-stake bag, the FTL withdraws the stake, and the FTM closes and replaces the bag.

6. The FTM takes a numbered cartridge vial corresponding to the designated sample point number from the vial bag, opens the vial, and places the cartridge into the FTL's gloved hands. The FTM then caps and replaces the empty vial in the holder and seals the vial bag.

7. The FTL affixes the cartridge to a stake by inserting the stake's hook through the top loop of the wire coil around the cartridge (see Figure B-8) and pushing the collector assembly into the ground within the scored area. (If the stake will not penetrate the earth or stay in position, use the shell to hold it upright, and note this variation on the Daily Activity Log to ensure that proper care is taken during retrieval.)

8. The FTM covers the sampler assembly by embedding the collection shell into the soil to a depth of 1/4 to 1/2 in (If this is not possible, the FTM will pack soil or sand around the base of the shell.)

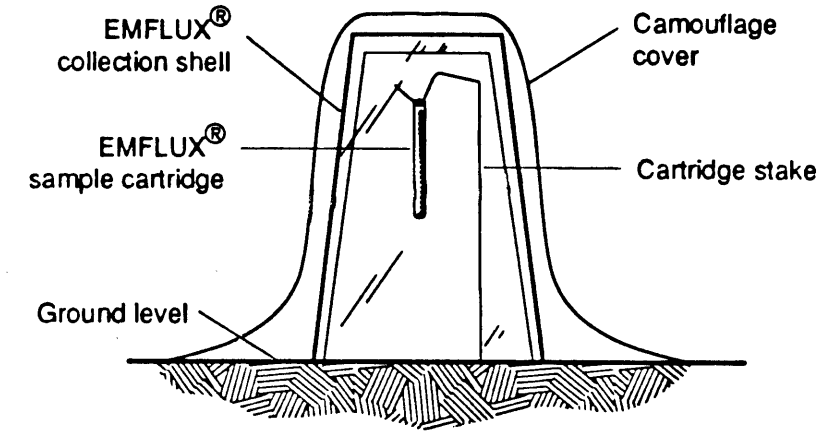
9. When the shell is in place, the FTM will cover it with camouflage cloth and secure the cloth with soil and/or rocks.

10. The FTM closes the field kit and records on the Daily Activity Log the following information: sample-point number; date and time of emplacement (to nearest minute); and other information deemed relevant (e.g., unusual weather or ground conditions). The FTL changes gloves if they are contaminated (not normally necessary at each sample point).

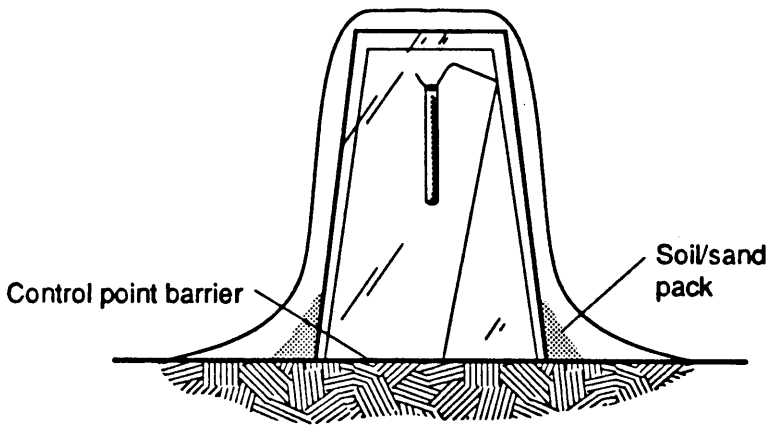
11. The team moves to the next location.

4.2 Procedure for Control-Point Deployment of EMFLUX® Sample Cartridges

1. The FTM opens the control-point barrier bag. The FTL, wearing plastic gloves, removes the foil barrier from the bag and places it at the selected sampling location. The FTM then opens the cartridge-stake bag, the FTL withdraws the stake, and the FTM closes and replaces the bag.



Deployment of sampler assembly and collection shell



Deployment of field control point

Figure B-8 EMFLUX® passive air sampling device assembly.

2. The FTM takes a numbered cartridge vial corresponding to the sample point number from the appropriate bag, opens the vial, and puts the cartridge into the FTL's gloved hands. The FTM then closes the empty vial, replaces it in the holder, and seals the bag. The FTM lays the control point barrier (foil) on the ground near the selected sampling point.

3. The FTL affixes the cartridge to the stake by inserting the stake's hook through the top loop of the wire cartridge coil and holding the sampler assembly on top of the foil barrier until the assembly is supported by the collection shell (see Figure B-8). It must be noted in the Daily Activity Log if the stake is supported by the shell to ensure that proper care is taken during retrieval.

4. The FTM places the collection shell over the sampler assembly by pressing the shell firmly but gently onto the barrier (being careful not to tear the foil). The FTM packs soil or sand around the base to form a 2-in-high collar. The FTM then covers the shell and collar with camouflage cloth and secures the cloth with soil or rocks.

5. The FTM closes the field kit and records on the Daily Activity Log the following information: the control-point number; date and time of emplacement; and any other information deemed relevant. The FTL then changes gloves if they are contaminated.

4.3 Procedure for Retrieval of EMFLUX® Sample Cartridges

1. The FTM carries the field kit and plastic bags (for trash and equipment, as necessary) to, from, and between the sampling points whenever the FTL is wearing clean plastic gloves.

2. At each sample point, the FTM takes the numbered cartridge vial corresponding to the designated sample point number from the appropriate bag. The FTL dons plastic gloves, being careful to avoid touching surfaces which will contact EMFLUX® components.

3. The FTM loosens but does not remove the vial lid. The FTM, while holding the vial, then pulls aside the camouflage cloth and shell with the free hand.

4. When the FTL has retrieved the cartridge, the FTM then opens the receiving vial.

5. The FTL places the cartridge in the open vial, which the FTM then closes and replaces in the holder. The FTM seals the bag containing the vial and records on the Daily Activity Log the following information: date and time of retrieval (to the nearest minute), and any other notes deemed relevant.

6. The FTM stows the collector shell, camouflage cloth, cartridge stake, etc. The FTL changes gloves if they have become contaminated. The team then moves to the next sampling location.

7. After all samples have been retrieved, the team verifies that the bag(s) containing the cartridge vials have been properly sealed and that the plastic recovery bags have been tied shut.

8. The team completes the Chain-of-Custody/Request for Analysis form as required by LANL-ER-SOP-01.04, "Sample Control and Field Documentation."

9. The team ships the cartridges on the day of collection to the Sample Coordination Facility (SCF).

5.0 Tritium Sampling and Analysis

Soil samples for tritium analysis will be collected at MDA J. Tritium sampling of air will be conducted at MDA H. Both air and soil samples for tritium analysis will be collected at MDA G. Samples for tritium analysis will be collected in surface water runoff and cores for the borehole drilling program.

5.1 Sampling and Analysis of Airborne Tritium

Airborne tritium is often sampled as tritiated water (HTO) vapor by absorption onto a desiccant, such as silica gel. Air is drawn through a column containing the silica gel at a known volumetric flow rate for a known length of time. The water vapor absorbed by the silica gel is removed by distillation, and the HTO radioactivity is measured by liquid scintillation counting. The HTO concentration in air is calculated from the measured radioactivity and the total volume of air drawn through the silica gel column. To sample for HTO, follow these steps:

1. Place a weighed amount of silica gel in a column and attach an open-faced membrane filter holder containing a 0.45-µm membrane filter on the inlet end. Record the weight of the silica gel used. The purpose of the filter is to separate airborne particles from the HTO vapor being sampled. The silica gel can be obtained from a vendor who will provide lot number certification data with the product, and should contain an indicator to show when the desiccant is approaching saturation and should be removed for analysis.

   Caution: Take care to protect the silica gel from contact with water before use. This can be accomplished by storing the stock container of silica gel under anhydrous conditions, and placing the prepared column in a plastic bag until used in the field.

2. Connect the outlet end of the silica gel column to the airflow measuring system (consisting of the magnehelic and rotameter assembly) with plastic tubing and then to the vacuum pump. Draw air through the column at a rate of approximately 0.125 L/min. Record the date and time of day the sampling was started. Check the column periodically. If the silica gel

is near saturation, replace the column with a fresh one. Record the date and time of day the air flow through the old column was stopped, and the date and time of day the flow through the new column was started.

Caution: After the end of sampling, it is important to ensure that the column does not come into contact with water, or air with elevated humidity. This can be accomplished by placing the column in a properly labeled and sealed Tedlar® bag. It is not as important to guard against loss of water from the silica gel because the water is strongly absorbed at temperatures below approximately 100°C. Therefore, make sure the column is stored below 100°C until it is analyzed in the laboratory.

3. Transfer the silica gel from the column to a distillation flask, taking care to avoid contact with water. Attach a collection flask to the side arm of the distillation flask, cool the collection flask with ice water, and distill the water vapor into the collection flask.

   Caution: It is important to drive the distillation to completion because the vapor pressure of HTO is slightly lower than H_2O. As a result, the product collected early in the analysis will be slightly enriched in H_2O, causing errors in the HTO analysis.

4. Add approximately 10 ml of scintillation cocktail to the collection flask, shake, and transfer the mixture to a liquid scintillation vial. Wash the collection flask twice with 5 ml of liquid scintillation cocktail and add the washings to the scintillation vial. Label the cap of the scintillation vial with a unique identifying number.

5. Place the samples in a liquid scintillation counter, and record the sequence number of each sample on the appropriate form. Configure the liquid scintillation counter to count tritium radioactivity for 50 min per sample, or until 10,000 counts are collected.

6. Calculate the tritium concentration in air as described below (Section 5.4.2).

5.2 Sampling and Analysis of Tritium in Water

Surface water runoff samples will be collected for tritium analysis according to the procedures described in Section 1.0 of Appendix B. Filter the samples to remove particles and treat with activated charcoal to remove organic compounds. Count the treated water sample directly for tritium by liquid scintillation counting. The steps for this procedure follow.

1. Collect approximately 100-ml water samples for analysis, if available. The amount collected is not critical, but the volume should be measured and recorded. Acidify the sample to approximately 1% HNO_3 in the field. Apply the appropriate label to each sample, record the sample identity, and transport it to the laboratory for analysis.

2. Filter the sample through a 0.45-µm pore-size filter to remove particles, add approximately 500 mg of activated charcoal; stir, and filter.

3. Add 5 ml of the filtered and decolorized sample to 15 ml of liquid scintillation cocktail in a properly labeled scintillation vial. Place the samples in a liquid scintillation counter, and record the sequence number of each sample on the appropriate form. Configure the liquid scintillation counter to count tritium radioactivity for 50 min per sample, or until 10,000 counts are collected.

4. Calculate the tritium concentration in water as described below (Section 5.4.2).

5.3 Sampling and Analysis of Tritium in Soil

Surface sediment and soil samples will be collected according to the procedures described in Section 2.0 of Appendix B.

> Caution: It is important to ensure that the sample does not come into contact with water, or air with elevated humidity. This can be accomplished by immediately placing the sample in a properly labeled and sealed plastic bag.

1. Transfer the soil to a distillation flask, taking care to avoid contact with water. Distill HTO absorbed to soil samples as described above for silica gel samples.

   Caution: It is important to drive the distillation to completion, as described above for silica gel samples.

2. Prepare the HTO distillate for liquid scintillation counting. Configure the liquid scintillation counter to count tritium radioactivity for 50 min per sample, or until 10,000 counts are collected.

3. Calculate the tritium concentration in air as described below.

5.4 Tritium Concentration Calculations

5.4.1 Detection Method

All of the above methods isolate tritiated water for liquid scintillation counting. The scintillation cocktail converts the radioactivity to light, and the phototube responds by producing a charge pulse which can be counted. Consult the instrument manual for operation of the liquid scintillation counter.

5.4.2 Analytical Procedure and Calculations

The efficiency of the counter is determined using a quench curve. A quench curve is determined by counting a graded series of quench standards relative to an external standard pulse (ESP). The external standard is often ^{226}Ra or ^{133}Ba. The counting efficiency of each quench standard is plotted against the ESP to provide a quench correction curve. The quench correction factor (eff*) is often applied automatically in modern counters (see manual for details). The following example calculation assumes that the quench correction factor (eff*) must be made by hand.

Once the ESP and counts per minute (cpm) values for each sample are known from the liquid scintillation printout, the tritium concentration can be calculated from the following:

a) $$\text{dpm} = \frac{\text{(Sample cpm) - (Blank cpm)}}{\text{eff*}}$$

$$\mu\text{Ci tritium} = \frac{\text{dpm}}{2.66 \times 10^6 \text{ dpm}}$$

b) Tritium concentration in air:

$$\mu\text{Ci tritium/L}_{air} = \frac{\mu\text{Ci tritium} \times V_T/V_A}{F \times t}$$

Where:

dpm = disintegrations per minute
V_T = total volume of water distilled from silica gel (ml)
V_A = aliquot counted (ml)
F = air sampling flow rate (≈0.125 L_{air}/min)
t = total time sampling (min)

c) Tritium concentration in water:

$$\mu\text{Ci tritium/ml } H_2O = \frac{\mu\text{Ci tritium}}{V_A}$$

d) Tritium concentration in soil:

$$\mu\text{Ci tritium / g}_{sample} = \frac{\mu\text{Ci tritium} \times V_T/V_A}{M}$$

Where:

M = mass of sample (g)

6.0 Vapor Monitoring Well Installation and Soil Gas Sampling Procedures

New vapor monitoring wells will be installed at MDAs L and G. These new wells and the existing wells at these MDAs will be sampled for soil gas analyses. Soil gas sampling will also be conducted at MDAs J, H, L, and G during borehole sampling.

6.1 Vapor Monitoring Well Installation Procedure

Vapor monitoring wells will be installed in boreholes utilizing an instrumented sampling membrane emplacement system. The number and depth of gas sampling ports will be determined by the Operable Unit Project Leader and FTL based on the depth of the boreholes and field GC analysis results.

The following procedure will be used for installation of vapor monitoring wells:

1. Insure that the instrumented sampling membrane is constructed of a nonreactive material such as Teflon®.
2. Insure that all tube connections for sampling are marked to show sample port depth.
3. Install a support casing into the borehole leaving 2.5 ft of casing above the ground surface.
4. Install the instrumented sampling membrane in the borehole through the support casing.
5. Fill the instrumented sampling membrane with clean, washed sand.
6. Set a vented locking-steel protective casing over the support casing.
7. Position the top of the protective casing 1 to 3 in above the tube connections for the sampling ports.
8. Install a 3-ft-square, 4-in-thick concrete pad around the protective casing.
9. Mark the protective casing with an identification number using a metal stamp.
10. Collect gas samples using the procedure described in Section 6.2

6.2 Soil Gas Sampling Procedure for Existing Vapor Monitoring Wells

SUMMA® 6 L canisters or resin tubes will be used to collect soil gas vapor from vapor monitoring wells. The laboratory providing the precleaned, subatmospheric depressurized SUMMA® canisters will supply certificates of cleanliness for the canisters. Resin tube vendors will supply similar certificates, along with lot numbers.

All SUMMA® canisters and quality control (QC) samples will be filled with 3 L of atmosphere. Two resin tubes will be used in tandem to sample 3 L of atmosphere.

Samples will be collected based on time of maximum vertical gas movement and will occur once during a cool season (March, April, or May), and once during the following warm months (June, July, or August).

6.2.1 Sampling Procedures for Existing Vapor Monitoring Wells

The procedure described below uses SUMMA® canisters for sample collection.

1. Calibrate all equipment to be used prior to the sampling activity (refer to Section 13.0 of Appendix B for guidance).

2. Sampling equipment will be assembled and placed on new plastic sheeting at the wellhead (see Equipment List, Section 12.0 of Appendix B).

3. Unlock the wellhead and record the condition of the sample lines on the Sample Collection Log.

4. Establish the sample line interval depth by noting the attached sample interval tag. Record notations on the Sample Collection Log.

5. Review Tables 5.3-20 and 5.4-27 to determine the purge volume for the selected sample interval.

6. Attach the purge pump to the sample line using new internally-lined Teflon® tubing. There should be a 2-in section of medical-grade silicone tubing between the sample line and the new tubing to the pump that can be sealed with a clamp after the sample line has been purged. This tubing will be used to attach the TO-14 canister to the sample line.

7. The purging train includes a pump set at 500 ml/min and a calibrated flow meter (see Section 13.0 of Appendix B for Calibration Procedures).

8. Purge the sample line at a rate not to exceed 500 ml/min.

9. Record the starting ambient temperature and flow rate on the sample collection log.

10. While purging, the discharge line will be directed into a Tedlar® air-sampling bag. This bag will be sampled several times to allow for the field screening of all the pump gases by a portable GC, a FID (Foxboro or equivalent), or PID (Photovac MicroTIP® or equivalent).

11. The screening instrument must be calibrated prior to its use in this sampling effort. The on-site calibration records must include the vendor of the calibration gas, calibration gas chemical constituent, concentration, vendor lot number, and instrument response concentration.

12. The screening instrument will not be connected to the purge pump discharge because the connection might affect the purge volume.

13. Send results of the field screens to the laboratory along with the Chain-of-Custody/Request for Analysis form to provide information for analytical dilution and health and safety purposes for the staff cleaning the canisters. (see LANL-ER-SOP-01.04, "Sample Control and Field Documentation," for instructions on filling out the Chain-of-Custody/Request for Analysis form).

14. At the completion of purging, turn off the purge pump and simultaneously clamp off the short section of medical-grade silicone tubing. Record the volume purged on the Sample Collection Log.

    Procedures 15 through 26 have been taken from LANL-ER-SOP-06.22, "Canister Sampling for Organics-EPA Method TO-14."

15. Read SOP-06.22 and consult the analytical vendor who will be providing the canisters prior to sampling using air canisters. The referenced SOP is consistent with EPA's procedure for "The Determination of Volatile Organic Compounds (VOCs) in Ambient Air Using SUMMA® Passivated Canister Sampling and Gas Chromatograph Analysis," EPA Compendium Method TO-14.

16. The analytical contractor will clean and test the sample canister according to EPA guidance prior to shipment to the Laboratory.

17. The canister should arrive with a vacuum up to 0.05 mm Hg. The canister will be used in a grab mode. Collect 3 L from each sample interval.

18. The canister train consists of a short Teflon® tube from the calibrated flow meter, short tubing to the vacuum gauge, and short tubing to the canister valve. The connection between the vacuum gauge and the canister valve should be a sealing quick-connect, such as a Swagelock®.

19. The canister train is attached to the well sample port after verification of the correct interval by the Field Team Leader and canister Sampling Team Member. A Sampling Team Member who has not operated a canister should request a practice canister from the laboratory to practice opening and adjusting the flow rate and closing the canister valve prior to reaching ambient pressure inside the canister. [Caution: SUMMA® canisters will be rejected at the receiving laboratory if they are at ambient pressure. The cannister must have a slight negative pressure (subatmospheric)].

20. Record the initial canister vacuum reading on the Sample Collection Log.

21. Slowly open the valve and adjust the flow rate until it reads 500 ml/min.

22. The sample volume should be no more than 3 L.

23. Record the final vacuum reading of the gauge on the Sample Collection Log.

24. Record the ambient temperature.

25. Fill out the SUMMA® canister tag with the unique sample number, time, date, final vacuum readings, printed name of sampler, and signature of sampler.

26. Record the field screen values on the sample tag. If they are over 1,000 ppm, duct tape the readings to two sides of the canister.

27. Complete the Chain-of-Custody/Request for Analysis form as required by LANL-ER-SOP-01.04, "Sample Control and Field Documentation."

28. Complete the rest of the forms required by LANL-ER-SOP-01.04.

29. Pack the canister back into the shipping container in which it was received.

30. Record the waybill number on the Chain-of-Custody/Request for Analysis form and seal the DOT-approved shipping container.

31. Complete the Sample Collection Log; make appropriate notations on the Daily Activity Log.

32. Ship the canister on the day of collection to the SCF.

6.3 Soil Gas Sampling Procedure for Open Boreholes

SUMMA® canisters or resin tubes will be used to collect soil gas samples from open boreholes. All sample SUMMA® canisters or resin tubes and QC samples will be filled with 3 L of gas. Samples will be collected using a packer assembly for collection of soil gas.

The gas sampling procedure is as follows:

1. Remove all drilling tools from the borehole except for hollow stem augers or casing.

2. If hollow stem augers are used or if the hole is cased, pull the augers or casing back to expose a section of the borehole wall for sampling.

3. Place the packer canister over the borehole.

4. Insure that the packer membrane is clean and uncontaminated.

5. Attach a low-pressure, filtered air supply hose to the canister.

6. Evert the clean, uncontaminated packer membrane into the borehole to the desired depth.

7. Purge the isolated zone with ultra-purified GC-grade compressed air (zero/zero air).

8. Insure that all gas sampling equipment has been calibrated. Refer to Section 13.0 of Appendix B for guidance.

9. Assemble vapor sampling equipment on new plastic sheeting at the borehole (see Equipment List, Section 12.0 of Appendix B).

10. Establish the sample line interval depth and record on the Sample Collection Log.

11. Attach the purge pump to the sample line using new tubing internally-lined with Teflon®. Between the sample line and the new tubing to the pump there should be a 2-in piece of medical-grade silicone tubing that can be sealed with a clamp after the sample line has been purged. This short piece of tubing will be used to attach the TO-14 canister to the sample line.

12. The purging train includes a pump set at 500 ml/min and a calibrated flow meter (see Section 13.0 of Appendix B for Calibration Procedures).

13. Purge the sample line at a rate not to exceed 500 ml/min.

14. Record the starting ambient temperature and flow rate on the Sample Collection Log.

15. While purging, the discharge line will be directed into a Tedlar® air sampling bag. This bag will be sampled several times to allow for the field screening of all the pump gases by a GC instrument such as a FID (Foxboro or equivalent) or PID (Photovac MicroTIP or equivalent).

16. The screening instrument must be calibrated prior to its use in this sampling effort. The on-site calibration records must include the vendor of the calibration gas, calibration gas chemical constituent, concentration, vendor lot number, and instrument response concentration.

17. The screening instrument will not be connected to the purge pump discharge because the connection may affect the purge volume.

18. The results of the field screens will be sent to the laboratory along with the Chain-of-Custody/Request of Analysis (see LANL-ER-SOP-01.04, "Sample Control and Field Documentation," for instructions on how to fill out the

Chain-of-Custody/Request for Analysis form) in order to provide information for dilution prior to injection of analytical instrument and health and safety purposes for the staff cleaning the canisters.

19. At the completion of purging, turn off the purge pump and simultaneously clamp off the short section of medical-grade silicone tubing. Record volume purged on the Sample Collection Log.

Procedures 20 through 31 have been taken from LANL-ER-SOP-06.22, R0.

20. Prior to sampling using air canisters, read the above SOP and consult the analytical vendor providing the canisters. The referenced SOP is consistent with EPA's "The Determination of Volatile Organic Compounds (VOCs) in Ambient Air Using SUMMA® Passivated Canister Sampling and Gas Chromatograph Analysis," EPA Compendium Method TO-14, May 1988.

21. The analytical contractor will clean and test the sample canister according to EPA's guidance prior to shipment to the Laboratory.

22. The canister should arrive with a vacuum up to 0.05 mm Hg. The canister will be used to sample in a grab mode. Collect 3 L from each sample interval.

23. The canister train consists of a short Teflon® tube from the calibrated flow meter, short tubing to the vacuum gauge, and short tubing to the canister valve. The connection between the vacuum gauge and the canister valve should be a sealing quick-connect, such as Swagelock®.

24. The canister train is attached to the well sample port after verification of the correct interval by the FTL and canister Sampling Team Member. If the Sampling Team Member has not operated a canister, he/she should request from the laboratory a practice canister to practice opening and adjusting the flow rate and closing the canister valve prior to reaching ambient pressure inside the canister. [Caution: SUMMA® canisters will be rejected at the receiving laboratory if they are at ambient pressure. The canister MUST have a slight negative pressure (subatmospheric)].

25. Record the initial canister vacuum reading on the Sample Collection Log.

26. Slowly open the valve and adjust the flow rate until it reads 500 ml/min.

27. The sample volume should not exceed 3 L.

28. Record the final vacuum reading of the gauge on the Sample Collection Log.

29. Record the ambient temperature.

30. Fill out the SUMMA® canister tag with the unique sample number, time, date, final vacuum readings, printed name of sampler, and signature of sampler.

31. Record on the sample tag the field screen values. If over 1,000 mg/L, duct tape the readings to the two sides of the canister.

32. Complete the Chain-of Custody/Request for Analysis form as required by LANL-ER-SOP-01.04.

33. Complete the rest of the forms required by LANL-ER-SOP-01.04.

34. Pack the canister back into the shipping container in which it was received.

35. Record the waybill number on the Chain-of-Custody/Request for Analysis form and seal the DOT-approved shipping container.

36. Complete the Sample Collection Log and make the appropriate notations on the Daily Activity Log.

37. Ship the canister to the SCF on the day of collection.

6.4 Types of Analyses to be Conducted in the Field

- Measurements of VOC concentrations will be made using calibrated PID and FID instruments while purging the sample collection line.

- Field screen measurements are to be taken from bag samples collected from the discharge line of the vacuum pump while operating in the purge mode.

- If sample bags are to be used more then once, they should be triple-rinsed with zero-zero laboratory air, then filled with zero-zero laboratory air and stored overnight. The air in the bag should be screened using field screening instruments, and the results should be recorded on the Sample Collection Log for the sample for which the recleaned bag will be used as part of the sampling equipment.

7.0 High-Volume Air Sampling

High-volume air samples will be collected at both MDA G and MDA L. The sampling procedures are described below.

7.1 Sampling Methods

Prior to the start of the sampling program, the air sampling equipment (high-volume particulate air sampling system and GPS-1 high-volume air sampler) will be calibrated in situ following procedures described in Section 13.7. The high-volume particulate air sampling system and the GPS-1 high-volume air sampler are shown in Figures B-9, B-10, and B-11.

7.1.1 High-Volume Particulate Air Sampler Operation

High-volume particulate air samplers are used to sample for total suspended particulates (TSPs). Glass-fiber paper filters are used in this sampling method. Care must be taken to ensure that the clean, weighed filters are not damaged or soiled prior to installation in the high-volume particulate air sampler. They should be kept in a protective folder or box, and must not be bent or folded.

7.1.1.1 Filter Installation Procedure

1. Open the shelter and remove the faceplate of the sampler by loosening the four wingnuts and swinging the bolts outward.

2. Wipe all dirt from the support screen and faceplate.

3. Center the filter with the rough side up on the wire screen so that the gasket will form an airtight seal on the outer edge (1 cm) of the filter when the faceplate is in position. When aligned correctly, the edges of the filter will be parallel both to the edges of the screen behind it and to the faceplate gasket above it. Poorly-aligned filters show uneven white borders around the filter.

4. Tighten the four wingnuts just enough to prevent leakage when the filter is aligned and the faceplate is in place. Excessive tightening may cause the filter to stick or may permanently damage the gasket.

5. Carefully insert a new recording chart into the flow recorder without bending the pen arm beyond its limits of travel. An easy way to do this is to raise the pen head by pushing in on the very top of the pen arm with the right hand while inserting the chart with the left hand. Be careful not to damage or weaken the center tab on the chart, but be sure the tab is centered on the slotted drive so that the chart will rotate the full 360° in 24 hrs without binding or slipping.

6. Check to see that the pen head rests on zero (i.e., the smallest circle diameter on the chart). If not, tap the recorder lightly to make certain that the pen arm is free.

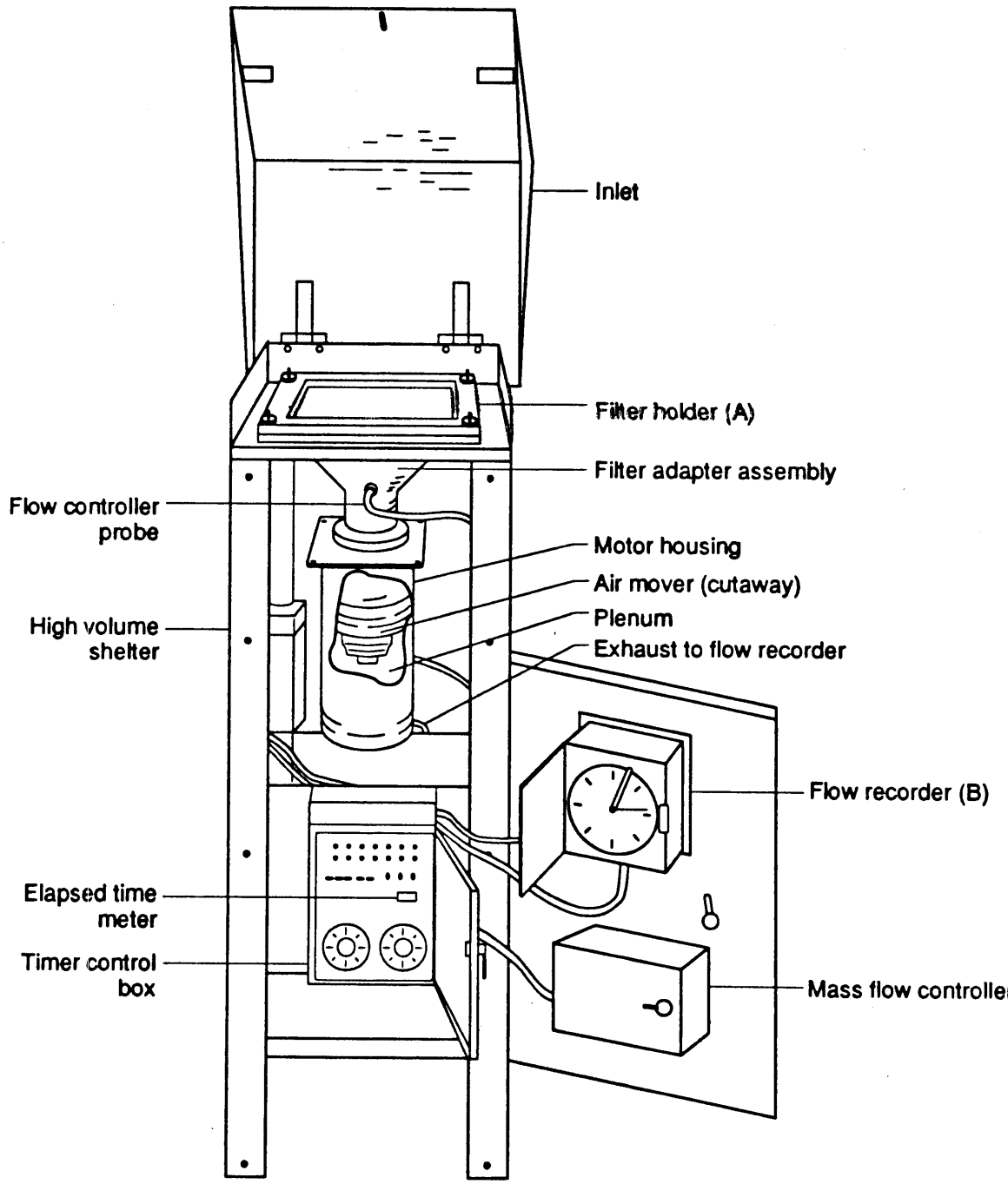


Figure B-9 High-volume air particulate sampling system.

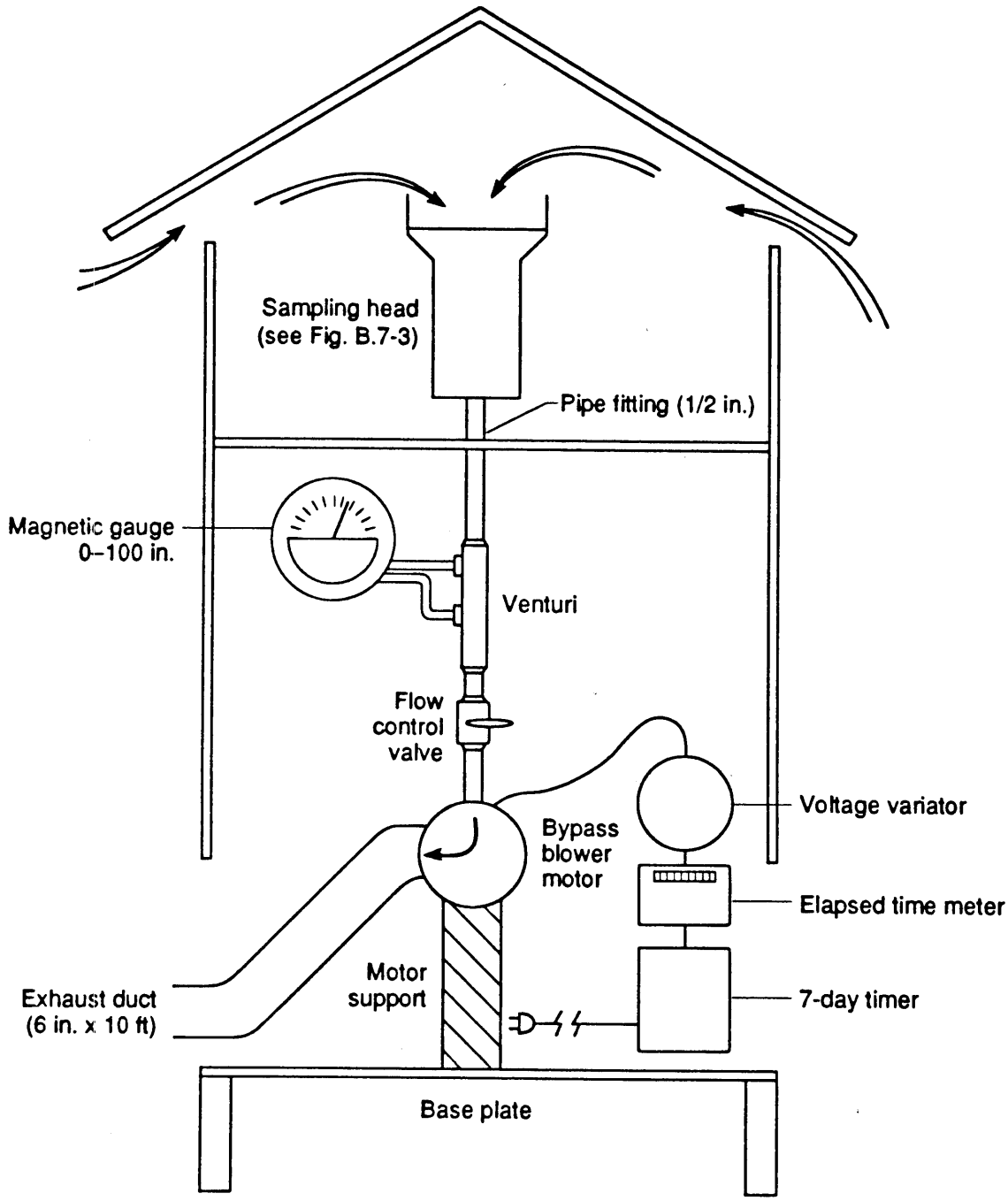


Figure B-10 GPS-1 high-volume air sampler.

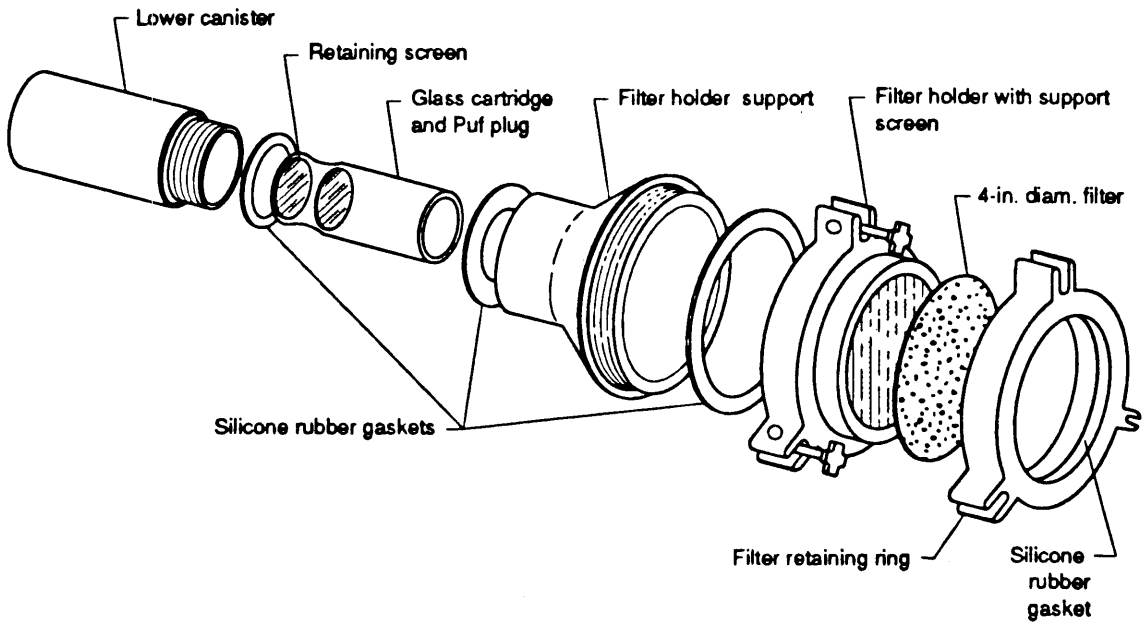


Figure B-11 Sampling head of GPS-1 high-volume air sampler.

7. Check the time indicated by the pen. If it is in error, rotate the chart clockwise by inserting a screwdriver or coin into the slotted drive in the center of the chart face until the time is correct. If the sampler is started with a timer switch, the correct time is the starting time on the timer.

8. Close the shelter and run the sampler for at least 5 min to establish run-temperature conditions.

9. Record the flow indicator reading and, if needed, the barometric pressure ($P_{3\ initial}$) and the ambient temperature ($T_{3\ initial}$), then stop the sampler. For individual pressure and temperature corrections, the ambient pressure and temperature at the time of the flow indicator reading can be obtained by on-site measurements or from the closest weather station.

10. Determine the flow rate from the sampler's calibration relationship to verify that it is operating within the acceptable range of 1.1 to 1.7 m^3/min (39 to 60 ft^3/min). If it is not within this range, use a different filter or adjust the sampler flow rate.

11. Record the sample identification information (filter number, site location or identification number, and sampling date) and the initial flow rate (or flow indicator reading, temperature, and barometric pressure, if needed) on the Hi-Vol Field Data Form.

12. Set the timer to start and stop the sampler so that the sampler runs for 24 hrs.

7.1.1.2 Retrieval of Exposed Filter Procedure

1. Recover the exposed filter as soon as practical following the sampling period.

2. Record the average flow indicator reading from the recorder chart and, if needed, the barometric pressure ($P_{3\ final}$) and the ambient temperature ($T_{3\ final}$).

3. Remove the faceplate and lift the exposed filter from the supporting screen by grasping it gently at the ends, not at the corners.

4. Evaluate particulate samples in the field for alpha and beta-gamma activity using standard survey meters. Record readings on the Hi-Vol Field Data Form.

5. Check the filter for signs of air leakage. Leakage may result from a worn faceplate gasket or from an improperly installed gasket. If signs of leakage are evident, void the sampler, determine the cause, and take corrective actions before starting another sampling period.

6. Visually inspect the gasket face to see if glass fibers from the filter remain as a result of overtightening of the faceplate wingnuts and the consequent cutting of the filter along the gasket interface.

7. Check the exposed filter for physical damage that may have occurred during or after sampling. Physical damage after sampling would not invalidate the sample if all pieces of the filter were put in the folder. Sample losses resulting from leakages during the sampling period or loss of loose particulates after sampling (e.g., loss when folding the filter) would invalidate the sample, however, so mark such samples "void" before forwarding them to the SCF.

8. Fold the filter lengthwise at the middle with the exposed side in; if the collected sample is not centered on the filter (i.e., the unexposed border is not uniform around the filter), fold so that only sample deposit touches sample deposit.

9. Place the filter in its numbered folder.

10. Determine the final flow rate from the sampler's calibration relationship and record it on the data record along with other pertinent information.

11. Remove the sampler's flow recorder chart and place the chart inside the filter folder with the inked side against the folder and the back side against the filter.

Field documentation and sample preservation and handling procedures, as described in Sections 8.0 and 9.0 of Appendix B, will be followed.

7.1.2 GPS-1 High-Volume Air Sampler Procedure

GPS-1 high-volume samplers are used to sample for constituents other than total suspended particulates (e.g., SVOCs, metals, pesticides, PCBs, and radionuclides). PUF filters/XAD cartridges are used in this sampling method.

1. Prepare cleaned, assembled sampling modules before each sampling period. Place modules upright in the specially designed refrigerated carrier for transport to the site.

2. Perform a single-point flow-check audit before each sampling period utilizing the Calibration Flow Rate Transfer Standard.

3. Prior to the flow-check audit, attach the flow-check module and the transfer standard to the sampler. This module is loaded with the same type of filter and sorbent media used for sampling, but it is to be used for flow-checking only.

4. Turn the sampler on and allow 10 min for warmup. Adjust the sampler flow to the desired flow of 0.20 to 0.28 m^3/min, as indicated by the magnehelic gauge reading and referenced by the calibration chart.

5. Attach one side of the manometer to the pressure tap of the transfer standard; leave the other side open to the atmosphere.

6. Record the pressure differential indicated for the transfer standard (H) in inches of water and the observed magnehelic gauge reading (M) in inches of water on the Flow Check Data Sheet (Figure B-12). Be sure both are stable before readings are taken.

7. Record the ambient temperature and barometric pressure.

8. Using the previously established Flow Rate Transfer Standard calibration curve, determine the audit flow (Qts). Using the previously established Venturi calibration curve, calculate the indicated sampler flow (Qs). Record both on the Flow Check Data Sheet.

9. Calculate the percent difference using the following equation:

$$\text{Percent difference} = \frac{Qs - Qts}{Qts} \times 100$$

where Qs = flow rate of the sampler as determined from the magnehelic reading, and

Qts = flow rate as measured by the transfer standard.

If the percent difference is greater than ±7%, the sampler will be recalibrated before sampling is continued.

10. Shut off the sampler and remove the flow check module and transfer standard.

11. Remove the top and bottom covers from the clean sampling module and attach the module to the sampler. Turn the sampler on. Allow 5 min for the sampler to warm up. Verify that the magnehelic gauge is still at the correct setting. If it is outside the flow rate of 0.20 to 0.28 m^3/min, the flow control should be adjusted. Record the magnehelic reading on the Sampling Field Data Sheet (Figure B-13).

12. Shut off the sampler.

13. On the Sampling Field Data Sheet, record the initial magnehelic reading, elapsed-time meter reading, sampler serial number, filter number, and adsorbent sample number.

14. Make sure the sample timer is set to turn on at the proper time.

	Date	Reading	Flow Rate	% Difference
SITE 1	Sampler	M _____ in.	Q_s _____ m^3	_____ %
	Transfer Standard	H _____ in.	Q_{ts} _____ m^3	Time _____
SITE 1 DUPLICATE	Sampler	M _____ in.	Q_s _____ m^3	_____ %
	Transfer Standard	H _____ in.	Q_{ts} _____ m^3	Time _____
SITE 2	Sampler	M _____ in.	Q_s _____ m^3	_____ %
	Transfer Standard	H _____ in.	Q_{ts} _____ m^3	Time _____
SITE 3	Sampler	M _____ in.	Q_s _____ m^3	_____ %
	Transfer Standard	H _____ in.	Q_{ts} _____ m^3	Time _____
SITE 4	Sampler	M _____ in.	Q_s _____ m^3	_____ %
	Transfer Standard	H _____ in.	Q_{ts} _____ m^3	Time _____
	Temperature		$\% \text{ Difference} = \frac{Q_s - Q_{ts}}{Q_{ts}} \times 100$	
	Barometric Pressure			
	Operator	Checked by		

Figure B-12 Example GPS-1 flow check data sheet.

	Sampling Date				
SITE 1	Cartridge ID		Filter ID		Sampler ID
	Start	*Elapsed Time*	*Magnehelic Reading*	*Flow Rate*	*Total Volume*
	Stop				
	Run Time		Avg. in.	Avg. m^3	Avg. m^3
SITE 1 DUPLICATE	Cartridge ID		Filter ID		Sampler ID
	Start	*Elapsed Time*	*Magnehelic Reading*	*Flow Rate*	*Total Volume*
	Stop				
	Run Time		Avg. in.	Avg. m^3	Avg. m^3
SITE 2	Cartridge ID		Filter ID		Sampler ID
	Start	*Elapsed Time*	*Magnehelic Reading*	*Flow Rate*	*Total Volume*
	Stop				
	Run Time		Avg. in.	Avg. m^3	Avg. m^3
SITE 3	Cartridge ID		Filter ID		Sampler ID
	Start	*Elapsed Time*	*Magnehelic Reading*	*Flow Rate*	*Total Volume*
	Stop				
	Run Time		Avg. in.	Avg. m^3	Avg. m^3
SITE 4	Cartridge ID		Filter ID		Sampler ID
	Start	*Elapsed Time*	*Magnehelic Reading*	*Flow Rate*	*Total Volume*
	Stop				
	Run Time		Avg. in.	Avg. m^3	Avg. m^3
	Field Operator On			Date	
	Field Operator Off			Date	
	Sample Custodian	Date Received		Checked By	

Figure B-13 Example GPS-1 sampling field data sheet.

15. At the end of the desired sampling period, the timer will turn off the sampler.

16. Before the sampler module is removed, a final flow reading must be taken. Turn the sampler on and let it warm up for 5 min. Take the final magnehelic reading and shut off the sampler.

17. Carefully remove the sample module and replace the top and bottom covers before placing the module in the refrigerated sample carrier. Caution should be taken to keep the module in the vertical position to prevent particle loss from the filter.

18. Record the ambient temperature and barometric pressure on the Flow Check Data Sheet.

19. Place the sealed sample modules in the specially designed refrigerated carrier. The sampling module will be disassembled in the laboratory, and laboratory personnel will recover the filter and XAD cartridge.

Field documentation and sample preservation and handling procedures, as described in Sections 8.0 and 9.0 of Appendix B, will be followed.

8.0 Field Documentation

Proper field documentation is necessary to maintain proper sample control and promote legally defensible data. Field documentation procedures will follow LANL-ER-SOP-01.01, "General Instructions for Field Investigations," and LANL-ER-SOP-01.04, "Sample Control and Field Documentation." Sample custody procedures will be followed through sample collection, transfer, and subsequent analysis to ensure that the integrity of the samples is maintained throughout the process.

8.1 Sample Identification

All unique sample numbers will be prepared according to the procedures presented in LANL-ER-SOP-01.04, "Sample Control and Field Documentation." Sample containers will be labeled with a unique sample number and the following information: sample location, sample date and time, and the sample's analytical program.

Sample identification documents will be carefully prepared so that sample documentation and Chain-of-Custody/Request for Analysis legal records can be maintained and sample disposition can be controlled. All forms will be filled out with waterproof ink. The following sample identification documents will be used:

- unique sample stickers,
- sample labels,
- Sample Collection Logs;
- Chain-of-Custody/Request for Analysis Record forms, and
- custody seals.

Examples of these forms are presented in LANL-ER-SOP-01.04, "Sample Control and Field Documentation."

8.1.1 Unique Sample Stickers

A sheet of preprinted sample stickers will be provided by the ER Program Office (EM-13) for each sample collected. Each sheet will have ten similarly numbered sample stickers with a unique six-character alphanumeric and bar code identifier. The FTL will obtain sufficient sheets of stickers in numeric order from the Custodian of Controlled Documents to complete the sampling effort. The number will be unique to each sheet of sample stickers and, therefore, for each sample. Unique sample stickers will be affixed to the following:

- sample labels,
- sample containers (including SUMMA® canisters, resin tubes, EMFLUX® cartridges, etc.),
- Sample Collection Logs,
- Chain-of-Custody/Request for Analysis Record forms,
- Daily Activity Logs, and
- Master Collection Logs.

Any remaining stickers not used will be destroyed and discarded.

8.1.2 Sample Labels

Sample labels also identify samples. Preprinted sample labels will be provided by the SCF. When necessary, the label will be protected from water and solvents with clear tape. Each label will provide the following information:

- name of collector,
- date and time of collection,
- site location,
- sample location,
- container serial number (if applicable),
- unique sample sticker,
- sample number,
- type of analysis, and
- preservative (if any).

If field screening instruments indicate VOCs in the sample are above 1,000 ppm or greater, then a warning label displaying the measured values must be affixed to the sample container along with the sample label.

8.1.3 Sample Collection Log

The FTL is responsible for completing and recording all information pertinent to the collection of samples on the Sample Collection Log. The borehole log will serve as the Sample Collection Log for rock core samples. Daily entries in this log will include:

- name and title of author, date (day-month-year) and time (24 clock, e.g., 1 pm = 1300) of entry, and physical/environmental conditions during field activities;
- TA and OU numbers;
- sample identification numbers;
- unique sample sticker(s) affixed;
- location of sampling activity;
- names and titles of other field team members;
- types of media sampled;
- sample collection method;
- description of sampling intervals;
- sample preservation;
- calibration procedures for field equipment;
- alpha, beta, and gamma radiation screening results;
- PID/FID screening results; and
- field observations/comments.

Note: Cross reference above information on all other applicable forms.

8.1.4 Chain-of-Custody/Request for Analysis Record Forms

A Chain-of-Custody/Request for Analysis Record form will be filled out for and will accompany every sample and every shipment of samples to the SCF in order to establish the documentation necessary to trace sample possession from the time of collection to final disposition. An example of the Chain-of-Custody/Request for Analysis Record form to be used is given in LANL-ER-SOP-01.04, "Sample Control and Field Documentation." Chain-of-Custody Record procedures are also included in LANL-ER-SOP-01.04. Copies of the Chain-of-Custody/Request for Analysis Record form are retained in the field files, by the SCF and the analytical laboratory, and in the project investigation files. When transferring custody of the samples, the

individual relinquishing and the individual receiving the samples will sign, date, and note the time on the Chain-of-Custody/Request for Analysis Record form. The shipping company does not have to become a part of the chain-of-custody procedures. (Caution: Custody will be broken and resampling must be done if the relinquish block of the form has no signature.)

8.1.5 Custody Seals

Samples will be packaged properly for shipment and dispatched to the SCF and then to the appropriate laboratory for analysis. A seal will be placed over the valve knob of each SUMMA® canister, around the caps at each end of the EMFLUX® cartridges, and over the lid of each sample container. The samples will then be placed in a DOT-approved shipping container. Binding tape will be placed around the shipping container, and a custody seal will be placed over the binding tape. The custody seal will be signed and dated. (Caution: Do not place custody seal tape over 40 ml sample container Teflon® septas.)

8.2 Field Summary Documentation

All field activities, including results of field investigations and sampling, will be documented. The forms and logs required for field documentation are described briefly below. Each form will be signed and dated.

8.2.1 Tailgate Safety Meeting Form

A tailgate safety meeting will be conducted at the beginning of each field day. The signatures of the participants in these meetings will be recorded on the Tailgate Safety Meeting Form.

8.2.2 Daily Activity Log

The FTL is responsible for preparing a Daily Activity Log that briefly summarizes each day's progress, describes general field conditions encountered, notes special problems, weather conditions, and sampling times, and includes sketches and calculations that pertain to the job. Data on subcontractors, such as equipment suitability/adequacy and progress towards the work schedule, may also be noted on this log. The Daily Activity Log will include the names and affiliations of all personnel on site. The FTL may note supplies and equipment used, decontamination practices (time decontamination is performed and the results of equipment inspection after decontamination), and any additional field observations or comments pertinent to the investigation. The Daily Activity Log will be completed according to the procedures outlined in LANL-ER-SOP-01.04, "Sample Control and Field Documentation."

8.2.3 Master Collection Log

A log in spreadsheet format will list all samples and their status. This log will be completed according to LANL-ER-SOP-01.04.

8.2.4 Variance Log

All approved changes or deviations that do not meet project/procurement document criteria, contractual scope of work, approved work procedures, or acceptable engineering practices will be documented on a Variance Log. This log will be filled out following the guidance provided in LANL-ER-SOP-01.04.

8.2.5 Waste On-Site Summary

A report will be made of the approximate amount and type of waste present, as provided in LANL-ER-SOP-01.04.

8.3 Correction to Documentation

Original data recorded on Daily Activity Logs, Chain-of-Custody/Request for Analysis Record forms, and other forms will be written in indelible ink. None of these documents will be altered, destroyed, or discarded, even if they are illegible or contain inaccuracies that require replacement documents.

If an error is made on a document, Field Team Members will make corrections by crossing a single line through the error, entering the correct information, and initialing and dating the change.

9.0 Sample Preservation and Handling Procedures

The use of specific preservation and handling procedures is important because the integrity of any sample is diminished over time. Because the various target analyte parameters are uniquely altered at varying rates, distinct sample containers, preservation techniques, and handling procedures have been established to maintain sample integrity for a reasonable and acceptable period of time. Requisite sample containers, preservation techniques, and holding times for analytical parameters and media are listed in Table B.9-1 and in LANL-ER-SOP-01.02, "Sample Containers and Preservation." Sample handling, packaging, and shipping procedures are described in LANL-ER-SOP-01.03, "Handling, Packaging, and Shipping of Samples." All samples will be packaged to meet DOT requirements and transported to the SCF.

Field personnel are responsible for the identification, preservation, packaging, handling, shipping, and storage of samples obtained in the field. This is important so that all samples can be readily identified and they will retain, to the extent possible, in situ characteristics to be determined through testing. Specifically, this will be the responsibility of the designated sampling person as directed by the FTL or OUPL.

Samples will be adequately marked for identification at the time of collection. Marking will be on a tag or label attached to the sample container. Sample identification will include, as a minimum

- project name and number,
- unique sample number,
- sampling location,
- sampling date and time,
- individual performing the sampling, and
- preservation or conditioning employed.

The FTL will maintain all field data for testing. Chain of Custody/Request for Analysis Record forms will be returned to the SCF with the samples.

Data results obtained from chemical analyses should demonstrate that the samples were obtained from the locations stated and that they reached the laboratory without alteration. Evidence of sample collection, shipment, SCF receipt, laboratory receipt, and laboratory custody until disposal must be documented as required by LANL-ER-SOP-01.04, "Sample Control and Field Documentation." Documentation will be accomplished through a Chain-of-Custody Record form that records each sample and the individuals responsible for sample collection, shipment, and receipt.

9.1 Surface Water, Surface Sediment, and Borehole Samples

Surface water, surface sediment, and borehole (soil/rock core) samples will be preserved according to the specifications listed in Table B.9-1. The sample containers will be sealed and labeled, placed in the shipping container, and packed with vermiculite and ice (if required). A Chain-of-Custody/Request for Analysis Record form will be filled out properly, placed in a plastic bag, and taped to the lid of the shipping container. The container is then transported to the SCF for subsequent shipment to the participating analytical laboratory.

9.2 Borehole and Passive Air Samples for Soil Vapor

To ensure proper preservation, SUMMA® canisters under negative pressure, resin tubes, and EMFLUX® cartridges will be placed in their original shipping containers with a Chain-of-Custody/Request for Analysis form, and then resealed. Samples will be shipped to the SCF on the day of collection. If the samples must be shipped the next day, they will be stored at 4°C. Resin tube samples will be wrapped in bubble wrap, placed in a Ziplock® bag, preserved with dry ice, and shipped to the SCF. It is important to note that dry ice will be considered "dangerous goods" if more than 5 lbs of it are shipped per container. The vendor of the resin tube must certify that the tubes can be frozen without breakage.

TABLE B.9-1
SAMPLE SPECIFICATIONS

Analyte	Method	Sample Container	Preservation	Holding Time
Soil/Rock Core				
VOCs	SW-846 8240[1]	4-oz glass, wide-mouth[2]	Cool to 4° C	14 days
SVOCs	SW-846 8270[1]	8-oz glass, wide-mouth[2]	Cool to 4° C	7/40 days[3]
Metals	SW-846 6010[1]	8-oz glass, wide-mouth[2]	Cool to 4° C	180 days
Mercury	SW-846 7470[1]	8-oz glass, wide-mouth[2]	Cool to 4° C	28 days
Radionuclides[5]	See Table 5.4-18	1-L glass, wide-mouth[2]	None	None specified
Tritium	See Table 5.4-18	1-L glass, wide-mouth[2]	Cool to 4° C, Isolate from moisture	None specified
Pesticides/PCBs	SW-846 8080[1]	8-oz glass, wide-mouth[2]	Cool to 4° C	7/40 days[3]
Cyanide	EPA Method 9010	4-oz glass, wide-mouth[2]	Cool to 4° C	14 days
Water				
VOCs	SW-846 8240[1]	40-ml glass VOA vials[2]	Cool to 4°C	14 days
SVOCs	SW-846 8270[1]	Two 500-ml amber glass[2]	Cool to 4°C	7/40 days[3]
Metals	SW-846 6010[1]	500-ml HDPE[4]	HNO_3 to pH < 2, Cool to 4°C	180 days
Mercury	SW-846 7470	250-ml HDPE[4]	HNO_3 to pH 2, Cool to 4°C	28 days
Radionuclides[5]	See Table 5.4-18	1-L glass, wide-mouth[2]	None	None specified

TABLE B.9-1, Continued
SAMPLE SPECIFICATIONS

Analyte	Method	Sample Container	Preservation	Holding Time
Tritium	See Table 5.4-18	glass, wide-mouth[2]	Cool to 4° C, Isolate from moisture	None specified
Pesticides/PCBs	EPA Method 608	Two 500-ml amber glass	Cool to 4° C	7/40 days[3]
Cyanide	EPA Method 335.2	1 L, HDPE	NaOH to pH 12 0.6 grams ascorbic acid	14 days
Soil Vapor				
VOCs	SW-846 8240[1]	6 L SUMMA® canister	None	14 days
VOCs	SW-846 8240[1]	Resin tube	Place in bubble wrap Freeze with dry ice	None specified
VOCs	SW-846 8240[1]	EMFLUX cartridge	Cool to 4° C	None specified
VOCs	SW-846 8240[1]	Carbon canister	Cool to 4° C	None specified
Organic Vapors	(PID/FID headspace)	16-oz glass, wide-mouth	None	24 hours
Organic Vapors	(Field GC headspace)	8-oz glass, wide-mouth	None	24 hours
Air				
SVOCs	SW-846 8270[1]	*See Footnote 6	Cool to 4° C	7/40 days[3]
Metals	SW-846 6010[1]	*See Footnote 6	Cool to 4° C	180 days
Mercury	SW-846 7000[1]	*See Footnote 6	Cool to 4° C	28 days
Radionuclides[5]	See Table 5.4-18	*See Footnote 6	Cool to 4° C	None specified

TABLE B.9-1, Continued
SAMPLE SPECIFICATIONS

Analyte	Method	Sample Container	Preservation	Holding Time
Tritium	See Table 5.4-18	Silica gel column	<100° C	None specified
Pesticides/PCBs	SW-846 8080[1]	*See Footnote 6	Cool to 4° C	7/40 days[3]
Total Suspended Particulates	40 CFR, Part 50 Appendix B, Section 2.2.11	GPS-1 glass-fiber paper filter envelope	None	14 days

[1] "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA-SW-846, Office of Solid Waste and Emergency Response, Washington, D.C., 20460, latest edition.
[2] All containers for rock core and water analysis must have Teflon-lined lids except for volatile organics which have Teflon-lined septa.
[3] Extract within 7 days; analyze within 40 days of extraction.
[4] HDPE - High density polyethylene bottles.
[5] All radionuclides except tritium.
[6] GPS-1 PUF filter/XAD resin trap; place filter and resin trap (i.e., sample module) in original shipping container and store at 4° C.

9.3 Tritium Samples

Tritium samples are collected in air-tight glass sample containers. The sample containers are then placed in plastic bags to ensure that the sample does not come in contact with water or high humidity air. Air tritium samples collected in silica gel columns must be stored at temperatures below 100°C; water and soil tritium samples will be stored at 4°C.

9.4 High-Volume Air Samples

GPS-1 high-volume air sample filters will be removed from the sampler with Teflon-coated tweezers, folded in half lengthwise with the exposed side in so that only sample deposit touches sample deposit, and placed into an envelope or folder. The unique sample number, name of the site worker, date and time, and other test conditions will be written on the sample envelope. The envelope will then be sealed and sent to the SCF, where the sample will be kept under strict custody in a temperature- and humidity-controlled environment.

A PUF/XAD high-volume air sample consists of two parts; the PUF filter and the XAD cartridge. The sample module (PUF filter and XAD cartridge) is removed from the sampler and placed in a refrigerated carrier, which is kept at approximately 4°C, and shipped to the SCF. The filter and cartridge are removed from the sample module at the analytical laboratory.

10.0 Field Quality Assurance

The following additional samples will be collected and sent to the analytical laboratory as part of the quality assurance (QA) evaluation. When appropriate, these samples will be submitted blind, with only collection sequence numbers and no further identification. The frequency of quality control (QC) sample collection is presented in Table B.10-1 and in LANL-ER-SOP-01.05, "Field Quality Control Samples." The goals of the QC samples are described in Section 15.0, PARCC Review.

10.1 Trip Blank

A trip blank is a sample container filled with High Performance Liquid Chromotography (HPLC) water that is received from the SCF and has a unique sample number. The container is taken to the field during a sampling event and then shipped back to the SCF along with the field samples. The trip blank remains unopened both from and to the SCF. One trip blank per 20 samples collected, or one trip blank per sample shipment if fewer than 20 samples are collected, will be submitted for each sampling device used for the collection of samples for VOC analysis.

TABLE B.10-1
QUALITY CONTROL SAMPLE SUMMARY FOR NONRADIOLOGICAL SAMPLES[a]

QC Sample Type	Matrix of Samples	Frequency	Purpose
Field Blank	Soil Water	1 per 20 samples* 1 per 20 samples*	To determine reagent and field contamination from other than sampling matrix.
Field Duplicate	Soil Water	1 per 20 samples 1 per 10 samples	To evaluate the reproducibility of the sampling technique.
Equipment (Rinsate) Blank	Soil Water	1 per 20 samples* 1 per 10 samples**	To evaluate decontamination procedures.
Trip Blank	Water	1 per shipping container for VOC[b] analyses only.	To determine contamination during storage and transport.

QUALITY CONTROL SAMPLE SUMMARY
FOR
RADIOLOGICAL SAMPLES[a]

QC Sample Type	Matrix of Samples	Frequency	Purpose
Field Duplicate	Soil Water	1 per 20 samples 1 per 20 samples (or less)	To evaluate the reproducibility of the sampling technique.
Equipment (Rinsate Blank)	Water used to rinse equipment	1 per 20 samples*	To evaluate decontamination procedures.

(a) Generic Quality Assurance Project Plan for RCRA Facility Investigations for the LANL ER Program, May 1991, Sections 5 and 10.
(b) VOC - Volatile Organic Compounds.
* or 1 per shipment if less than 20 samples are collected in a day.
** or 1 per shipment if less than 10 samples are collected in a day.

10.2 Field Blank

A field blank is a sample collected to assess background levels at the sampling site. The sample is collected using the same procedures followed for collecting other samples on site. Deionized water will be provided by the SCF; the water will be poured into a sample container and labeled as a sample. One field blank per 20 samples collected, or one field blank per sample shipment if fewer than 20 samples are collected, will be submitted for each sampling device used.

10.3 Duplicate Sample

A duplicate sample is a field sample divided into two samples. Both containers are filled simultaneously from the same sampling area and submitted to the SCF as consecutive samples. One duplicate sample per 20 samples collected, or one duplicate per sample shipment if fewer than 20 samples are collected, will be submitted. This QC sample is a collocated sample. A split sample is also a form of a collocated sample. A split sample is generated as an aliquot of a sample.

10.4 Equipment (Rinsate) Blank

An equipment (or rinsate) blank is a sample that is taken to assess the cleanliness of the sample equipment. The sample equipment is cleaned according to the procedures in Section 11.0, then deionized water is poured over the previously decontaminated equipment's sampling surface and collected in a sample container. One equipment blank per 20 samples collected, or one equipment blank per shipment if fewer than 20 samples, will be collected per sampling device.

11.0 Decontamination Procedures

Equipment decontamination procedures are described in Section 6.3 of the Laboratory's Generic QAPjP (LANL 1991, 0412). LANL-ER-SOP-01.06, "Management of RFI-Generated Waste," and Figures B-1 through B-7 of Appendix B of this RFI Work Plan provide information for the proper handling and disposition of fluids and other materials generated during equipment decontamination.

11.1 Decontamination Before Mobilization to the Field

To prevent contamination of the samples from outside sources, all sampling equipment will be cleaned prior to entering the site. Procedures for decontaminating equipment prior to mobilization to the field is listed below.

11.1.1 Sampling Equipment Decontamination

1. Wash equipment thoroughly with laboratory detergent and hot water, using a wire-free brush to remove any particulate matter or surface film.
2. Rinse equipment with hot tap water.
3. Rinse equipment with 10% nitric acid/deionized water solution.
4. Rinse equipment thoroughly with distilled water.
5. Rinse equipment with deionized water.
6. Rinse equipment twice with isopropanol and allow to air dry, loosely covered with foil, for at least 24 hours.
7. Wrap the equipment in aluminum foil with the inside (shiny side) of the roll toward the equipment.

11.1.2 Backhoe and Drill Rig Equipment Decontamination

The backhoe, drill rig, drill tools, pipe, casing, and related equipment will be steam cleaned before entering the site.

11.2 Field Decontamination Procedure

All equipment that comes in contact with potentially contaminated air, soil, water, or rock core will be decontaminated in the field prior to and after each use. Field decontamination procedures follow.

11.2.1 Sampling Equipment Decontamination

1. Clean equipment with tap water and laboratory detergent, using a wire-free brush if necessary to remove particulate matter and surface film.
2. Rinse equipment thoroughly with tap water.
3. Rinse equipment thoroughly with deionized water.
4. Rinse equipment twice with isopropanol.
5. Rinse equipment thoroughly with deionized water.
6. Allow equipment to air dry as long as possible.

11.2.2 Backhoe and Drill Rig Equipment Decontamination

Drilling tools, backhoe bucket, and related ancillary equipment will be steam cleaned to remove all foreign matter prior to use.

12.0 Equipment List

12.1 Field Documentation and Sample Identification Equipment

- Record storage box
- Waterproof pens
- Camera and film
- Tape (clear, duct, and custody)
- Unique sample stickers
- Sample labels
- Daily Activity Logs
- Chain-of-Custody/Request for Analysis forms
- Sample Collection Logs
- Custody seals
- Tailgate Safety Meeting Forms
- Master Collection Logs
- Calibration records
- Shipper's waybill copies
- Tablets for calculations
- Telephone logs
- Sampling and Analysis Plans
- Health and Safety Plans

12.2 Sampling Equipment

12.2.1 Surface Water Sampling Equipment

- ISCO 3700 portable sampler
- Operations manual
- Additional 12-volt automobile battery power supply
- Sample containers
- Precleaned sample collection composite jar (3-gallon, glass)
- Proper level of PPE
- New Telfon®-lined sample tubing
- New medical-grade silicon pump tubing
- 1,000-ml graduated cylinder (plastic)
- Stop watch
- ISCO field printer
- ISCO flow meter
- ISCO liquid level sensor actuator
- ISCO Type A interface
- Ice (3 bags per ISCO)

12.2.2 Surface Sediment Sampling Equipment

- Trowel, scoop, hand corer (stainless steel), or wooden tongue depressors
- Bowl [glass, aluminum (except metals), stainless steel]
- Sample containers
- Proper level of PPE
- Paper towels
- Ice

12.2.3 Soil and Rock Core (Borehole) Sampling Equipment

- Core trays
- Core boxes
- Sample containers
- Hammer and cold chisel
- Tape measure
- Stainless steel spatula, 6 1/2-in
- Stainless steel spoons
- Stainless steel scoops
- Reclosable plastic bags
- Stainless steel pans
- Glass bowls or pans
- Shipping coolers
- Packing materials (vermiculite, styrofoam peanuts, etc.)
- Ice
- Aluminum foil

12.2.4 Soil Vapor Monitoring Wells Sampling Equipment

- 1/4-in inside diameter tubing, internally coated with Teflon® (enough tubing for all wells to be sampled), certified by the vendor as VOC cleaned

- Sampling manifold consisting of Swagelock® pipe adapter, flow meter, Swagelock® union, vacuum gauge, Swagelock® union and adapter to canister valve body. All components are stainless steel and can be disassembled for decontamination.

- Vacuum pump - 12-volt DC variable flow to provide 10 to 800 ml/min of air

- Thermometer, direct-reading Pensky-Martens, Low, ASTM 9C, 0.5 Division

- Six-liter SUMMA® canisters in shipping containers

- One-liter gas sampling bags, Teflon® bag material with stainless steel or Teflon® fittings

- Six-liter gas sampling bags, Teflon® bag material with stainless steel or Teflon® fitting
- Vacuum box, sized to hold fully inflated 6 L bag, sealed and able to hold a vacuum, two inlets/outlets, one vacuum release valve

12.2.5 Passive Air Sampling Equipment

- Collection shells: conical or tubular stainless steel casing, open at one end, used to cover and shield collector assembly
- EMFLUX® sample cartridges
- Cartridge stakes: stainless steel support for sorbent cartridges; holds cartridge above ground and away from the sides of the collection shell
- Camouflage covers: cloth covers to make collection shells less visible
- Control paint barriers: metal foil used to isolate EMFLUX® solvent cartridges from soil-gas emission at each control point
- Disposable plastic gloves
- Camp shovel, short-handled hoe or trowel
- Soil or sand (10-20 lbs): in case usable soil is unavailable at sample point locations

12.2.6 High-Volume Air Sampling Equipment

- General Metal Works, Inc. (GMW) high-volume air sampling system Model GL 2000H
- Preweighed, high-purity glass-fiber filters, 8- by 10-in
- GMW Model GPS-1 high-volume sampling system
- High-purity, glass-fiber filters, 4-in diameter
- XAD-2 resin packed-glass cartridges with polyurethane foam (PUF) plugs on each end

12.2.7 Sludge Sampling Equipment

- Long-handled scoop with extensions to reach up to 18 ft
- Sample containers
- Dowel rods
- Tape measure
- Stainless steel spoons
- Reclosable plastic bags
- Glass bowls or pans

- Refrigerator or cooler with ice
- Shipping coolers
- Packing materials (vermiculite, styrofoam peanuts, etc.)
- Ice
- Aluminum foil

12.3 Decontamination Equipment

All sampling equipment will be decontaminated between and after each sampling event.

- Stainless steel or glass 12- by 24- by 2-in baking pans
- Distilled water
- Isopropanol, reagent grade
- Pipet cleaner brush, 1/2-in
- Kimwipes®
- Small hand tools to disassemble sampling equipment (Note: these tools will have also been decontaminated prior to use)
- Three Teflon® squirt bottles with exclusive labels (i.e., Methanol, Deionized Water), 500 ml
- Laboratory detergent, Liquinox® or equivalent
- Nitric acid, 10% reagent-grade nitric acid and deionized water
- Aluminum foil: inside of the roll is to be placed next to the cleaned sampling equipment
- Labels for all reagents and squirt bottles

12.3.1 Additional Decontamination Equipment

In addition to the decontamination equipment listed above, the equipment listed below will be necessary for decontamination of surface water, sediment, soil, and rock core sampling equipment.

- Galvanized steel tubs
- Medium and small size steel brushes
- Bristle brushes
- Plastic sheeting
- Steam cleaning unit
- Paper towels
- Pressure sprayer
- Pipe wrenches

12.4 Calibration Equipment

- 1,000-ml graduated cylinder
- Equipment manuals
- Calibration gas of known LEL for CGI calibration
- Calibration gas with known standard reading on 11.7 eV PID

- Regulator for calibration gas canisters
- Tygon tubing to connect regulator to equipment
- Span gas
- GMW Model G40 calibrating orifice
- National Institute of Standards and Technology traceable standard positive-displacement rotary-type (Roots Meter) meter

13.0 Field Equipment Calibration

All field equipment to be used in these Sampling and Analysis Plans will be calibrated according to the applicable Laboratory ER Program SOPs and the manufacturer's user manual, which will be included with the equipment. Calibration procedures and frequency of calibration are given in Section 8.0 of the ER Program Generic QAPjP (LANL 1991, 0412), and briefly below.

13.1 PIDs and FIDs

Frequency: The PIDs and FIDs will be calibrated at the beginning of each sample day or each time instrument is turned on.

Method: The manufacturer's manual will detail the method.

Documentation: Record calibration gas composition, concentration, manufacturer, lot number of calibration gas, instrument serial number, instrument reading of calibration gas concentration, battery check, alarm response data, and initials of operator on the Sample Collection Log.

13.2 Scintillation and NaI and Detectors

Alpha radiation will be field screened with a scintillation detector, or equivalent detection device. Beta and gamma radiation will be field screened with a NaI detector, or equivalent instrument. These instruments will be calibrated by the manufacturer once a year, unless Laboratory equipment is being used. If the radiation detection instruments are supplied by the Laboratory, the instruments will be calibrated by the Laboratory at least once a year. The instrument model and serial number and the date of calibration will be recorded on the Sample Collection Log.

13.3 Surface Water Runoff Sampling Equipment

Frequency: The ISCO automatic collection equipment will be calibrated prior to the start of the study, and will be checked as recommended in the equipment manual for flow rate, time, and volume.

Method: As specified in the equipment manual.

Documentation: The calibration and check data will be stored as part of the raw data file.

13.4 Soil Sampling Equipment

Frequency: The laboratory balance used to weigh samples will be calibrated prior to the start of the study and will be checked monthly.

Method: Standard weights will be used.

Documentation: The calibration and check data will be stored as part of the raw data file.

13.5 Flow Meter/Sampling Pump

Frequency: The flow meter will be calibrated at the beginning and ending of each sampling period. The FTL is responsible for the daily calibration of the flow meter. All calibration, unless otherwise specified, will be performed according to the manufacturer's range and accuracy specifications.

Method:

1. Set up the pump with the flow meter hooked to the intake side and 3 ft of silicon tubing hooked to the discharge side.

2. Fill a 2,000-ml graduated cylinder with water. Invert the graduated cylinder in a water bath without allowing air bubbles to flow into the graduated cylinder.

3. Set the pump speed to maintain a constant air flow reading. Record the reading on the Sample Collection Log.

4. Place the outflowing end of the silicone tube that is attached to the discharge port pump into the water bath, but not directly under the graduated cylinder.

5. Start a stop watch and simultaneously place the outflowing end of the silicon tube underneath the inverted graduated cylinder so that air bubbles flow up into the graduated cylinder. Record the flow rate reading.

6. After 1 min, stop the watch and simultaneously remove the tube from under the inverted cylinder.

7. Record the stop watch time and the water level in the inverted graduated cylinder on the Sample Collection Log. Determine the volume of water displaced and calculate the flow rate in ml/min.

8. Repeat the above procedure at the same flow rate setting. If the calculated flow rates are not within 5% for the two attempts, a third attempt will be made.

9. Repeat the procedure for three flow meter settings. The three settings should be at 200 ml/L, 500 ml/L and 700 ml/L on the flow meter scale.

10. Plot the data to ensure that the flow meter is linear.

11. Calibrate the flow meter before and after sampling.

Documentation: Record data on the Sample Collection Log for each sample.

13.6 Airborne Tritium Sampling Equipment

Frequency: The vacuum pump and rotameter will be calibrated prior to the start of the study and will be checked monthly.

Method: The above air metering assembly will be calibrated and checked using a dry test meter and a stopwatch.

Documentation: The calibration and check data will be stored as part of the raw data file.

13.7 GPS-1 (High-Volume) Sampling System

A multipoint calibration of the GPS-1 sampling system will be performed with a GMW Model G40 calibration orifice. The samplers will be calibrated following procedures given in the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Method TO-14.

13.8 Combustible Gas/Oxygen Detector

Frequency: This equipment will be calibrated at the beginning of each sample day or each time instrument is turned on.

Method: The manufacturer's manual will be followed for the correct method.

Documentation: Calibration gas composition, concentration, manufacturer, lot number of calibration gas, instrument serial number, instrument reading of calibration gas concentration, battery check, alarm response data, and initials of operator will be recorded on the Sample Collection Log.

14.0 Variance Situations

A nonconformance or variance situation is an uncontrolled and unapproved change or deviation that does not meet project/procurement document criteria, contractual scope of work, approved work procedures, or acceptable engineering practice. The FTL is responsible for documenting the nonconformance on the Variance Log and reporting it to the OUPL. The OUPL may consult the Quality Program Project Leader (QPPL) and document the findings on the Variance Log.

15.0 PARCC Review

Goals for analytical precision, accuracy, representativeness, completeness, and comparability (PARCC) have been established to gather quality data to properly investigate OU 1148. The objectives of the RFI and the intended use of the data define the PARCC parameter goals. The following sections outline the PARCC parameters as they apply to the OU 1148 RFI.

15.1 Precision

Precision measures the reproducibility of measurements under a given set of conditions (EPA 1987, 0291). Precision goals have been established for the analytical laboratory under EPA SW-846. The historical precision of SW-846 analytical methods for the contaminants has been determined from quarterly blind performance evaluation samples. The precision goals are presented the Laboratory's Generic QAPjP (LANL 1991, 0412) and are expressed in terms of relative percent difference (RPD), and maximum and minimum quantification values. Data acquired from the Laboratory's QAPjP are approximately $\pm$ 20% RPD precise for metals and Table V.11 of the QAPjP for organic analysis (LANL 1991, 0412).

Field contamination, sample preservation, and handling may also affect precision. Therefore, technical guidance on field decontamination and sample preservation and handling procedures are clearly described in this Appendix. Quality control samples will be examined to determine the precision which is actually achieved.

15.2 Accuracy

Accuracy measures the bias in a measurement system (EPA 1987, 0291). Accuracy goals have been established by the analytical laboratory under SW-846, and are measured in percent recovery. These goals are presented the Laboratory's QAPjP. Percent recovery from the data acquired from SW-846 is approximately 80% to 120% for a spiked sample, and 75% to 125% for an analyte spike. Sources of error in accuracy can result from inadequate or inconsistent field procedure; therefore, technical guidance for sampling has been provided for each activity in great detail in each SAP and this Appendix. Emphasis has been be placed on the use of equipment which reduces potential for contamination (i.e., glass, Teflon®, or stainless steel). In addition, after equipment is decontaminated, it will be protected to reduce potential contamination during transport. Changing gloves between

samples will also reduce potential for cross contamination. Use of LANL-ER-SOPs combined with technical guidance which directly applies to OU 1148 in each SAP and this Appendix are the primary means of attaining accuracy. Sampling accuracy and environmental conditions will be assessed through analysis of field, trip, and rinsate blanks, in addition to the collection of laboratory-blind duplicate samples. Quality control samples will be analyzed to determine the actual accuracy achieved.

Data validity with respect to precision and accuracy will be conducted by the analytical laboratory. Data validity will be assessed by laboratory QA/QC data and protocols routinely employed for validation of SW-846. Results which do not meet the minimum requirements for precision and accuracy will be rejected.

The SW-846 analytical program is designed to minimize data error. As a result resampling and rejection of data should be infrequent. Qualified, defensible data will be utilized to the most practical extent for site characterization and risk assessment.

15.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition (EPA 1987,0291). Sample representativeness will be achieved through the definition of a clear and consistent sampling program. The OU 1148 SAPs are designed to collect samples that are equally representative of actual site conditions. This has been accomplished through the careful common sense consideration of the appropriate sample location and area to be sampled, and the intended use of the data.

Sample locations (judgmental or unbiased) and sample types (grab or composite, intrusive or nonintrusive) are chosen to best acquire statistically valid data. The sampling programs, in general, propose statistically supported sampling locations which are unbiased within the individual SWMU locations to assure analytical data are suitable for their intended use and adequately characterize the site. Consistency in sample design is maintained within SWMU Aggregates and throughout the sampling programs by the presentation of state of the art technical methodology specific to OU 1148 in the SAPs.

15.4 Completeness

Completeness is defined as the percentage of measurements made which are judged to be valid (EPA 1987, 0291). The sampling and analysis program for OU 1148 is sufficiently broad in sampling technologies to prevent a single data point or parameter from sacrificing attainment of the RFI objectives. Sample data completeness will be achieved through Level III or Level V analytical techniques on a med a by media basis. Sampling and analytical error cannot be predicted, therefore Level III and Level V data will be acquired. This completeness range is acceptable because the program has been developed by EPA, who will review these data.

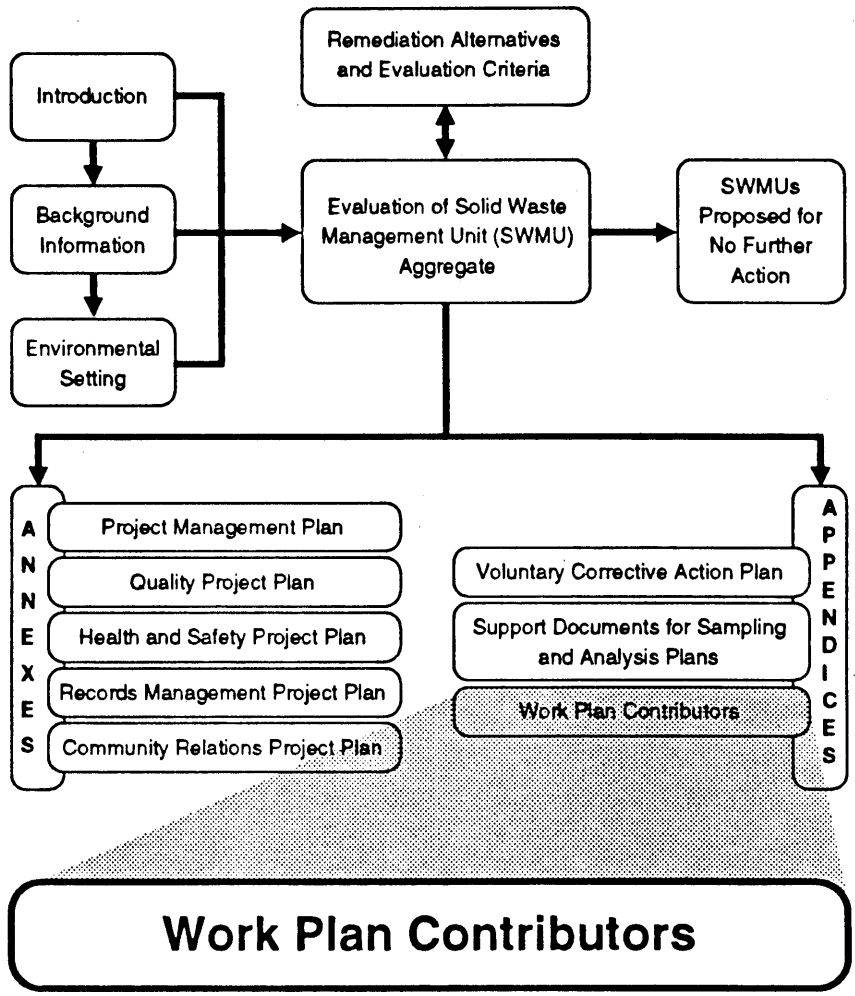
Analytical Levels I and II have a much lower completeness level. They will be used to provide real-time data to minimize delay and enable measurements to be repeated where necessary.

15.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another (EPA 1987, 0291). The use of standard EPA-published or -recognized sampling and analytical methods plus the use of the QC samples described above will ensure data of known quality. This data set can then be compared with any standard. In addition, data must be comparable between different sampling events. Standardization of the sampling approach has facilitated the development of a sampling program which will allow for comparability of data.

Comparability can be controlled through data collection mechanisms by utilizing both standard laboratory and field procedures described in the SAPs and this Appendix. Technical guidance is provided in the SAPs and this Appendix to help maintain comparability. Environmental conditions will also be taken into consideration for comparability.

APPENDIX C


Remediation Alternatives and Evaluation Criteria
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Health and Safety Project Plan
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Voluntary Corrective Action Plan
Support Documents for Sampling and Analysis Plans
Work Plan Contributors
Work Plan Contributors

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