RFI Work Plan for Operable Unit 1093

Environmental Restoration Program

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Executive Summary

RFI Work Plan for
OU 1093

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Purpose

The primary purpose of this Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) work plan is to determine the nature and extent of releases of hazardous waste or hazardous constituents from solid waste management units (SWMUs) in Operable Unit (OU) 1093 and to determine the need for corrective measures studies (CMSs). Secondly, this document satisfies part of the regulatory requirements contained in Los Alamos National Laboratory's (the Laboratory's) permit to operate under RCRA. OU 1093 includes all of Technical Areas (TAs) 18 and 65, former TA-27, and a portion of TA-36. Three potential release sites (PRSs) located in TA-54 (OU 1148) are also assigned to OU 1093. These technical areas are located in Los Alamos County. Within these technical areas are 45 PRSs, which are located entirely on land owned by the Department of Energy (DOE).

Module VIII of the RCRA permit, known as the HSWA Module (the portion of the permit that responds to the requirements of the Hazardous and Solid Waste Amendments [HSWA]), was issued by the Environmental Protection Agency (EPA) to address potential corrective action requirements for SWMUs at the Laboratory. These permit requirements are addressed by the DOE's Environmental Restoration (ER) Program at the Laboratory. This document describes the sampling plans that will be followed to implement the RFI at OU 1093, and, together with nine other work plans submitted to the EPA in May 1993 and nine work plans already submitted, meets the requirement set forth in the HSWA Module to address a cumulative percentage of the Laboratory's SWMUs in RFI work plans by May 23, 1993.

Installation Work Plan

The HSWA Module required the Laboratory to prepare an installation work plan (IWP) to describe the Laboratory-wide system for accomplishing the RFI, CMSs, and corrective measures, a requirement satisfied by the Installation Work Plan for Environmental Restoration originally submitted to the EPA in November 1990. That document is updated annually, and the most recent revision was published in November 1992. The IWP identifies the Laboratory's PRSs, describes their aggregation into 24 operable units, and presents the Laboratory's overall management plan and technical approach for meeting the requirements of the HSWA Module. When information relevant to this work plan has already been provided in the IWP, the reader is referred to the 1992 version of that document.

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

Background

TAs-18 and -27 were first used by the Laboratory during the Manhattan Project beginning in 1944. These sites were the location of experimental test shots, employing high explosives and various metals including depleted uranium. TA-27 has been inactive since 1945. Following World War II, work at TA-18 was involved primarily with criticality research, which has continued to the present time.

The area comprising OU 1093 lies primarily within Pajarito Canyon and a tributary, Threemile Canyon. The entire operable unit is underlain by volcanic deposits comprising the Bandelier Tuff. The tuff outcrops throughout the sides of the canyon that are nearly vertical, and the floors of the canyon are filled with alluvial material derived from the Bandelier Tuff and older formations. Intermittent streams flow in the bottom of both Pajarito and Threemile canyons upstream from the operable unit, and recharge a shallow groundwater body within Pajarito Canyon. Streamflow throughout the operable unit is ephemeral, occurring primarily as a result of snowmelt runoff. The piezometric surface of the main aquifer lies at a depth of approximately 300 ft below the surface within the western portion of the operable unit. Groundwater investigations in the eastern portion of OU 1093 did not detect any perched water between the shallow alluvial groundwater body and the main aquifer. It is believed that there is no hydraulic connection between the shallow and deep groundwater bodies.

The PRSs in OU 1093 consist of liquid waste management systems, (including sanitary, industrial, and radioactive waste); an inactive underground storage tank; inactive firing sites and associated structures; locations affected by previous leaks from polychlorinated biphenyl (PCB) transformers; storm sewer outfalls; materials disposal areas; and a bazooka impact area. Many of the inactive PRSs, such as firing sites used in the early 1940s, have been entirely decommissioned. Some PRSs, such as three septic systems and the storm sewer outfalls, are active and will remain so for the foreseeable future. However, many of the operations that generated wastes handled by the active PRSs are no longer being conducted, thus eliminating some sources of potential environmental release. Former releases at some PRSs, such as leaks from PCB transformers, were cleaned up at the time of the release.

Former investigations of potential environmental release within OU 1093 are a groundwater monitoring study within TA-18; sampling of sewage lagoons and outfalls associated with the now inactive portion of the central sanitary sewer system at TA-18; and construction and sampling of shallow wells east of TA-18. None of these investigations detected the presence of radioactive or hazardous constituents above background levels.

Although no previous investigations have identified the presence of contaminants of concern in the environment, the investigations are not sufficiently conclusive to rule out the presence of contaminants. Many PRSs are being proposed for no further action (NFA) on the basis of archival data, but most PRSs in this operable unit require some field investigations before determining if an NFA is appropriate.

Technical Approach

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

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

For most PRSs in OU 1093, including liquid waste management systems, an inactive underground storage tank, and storm sewer outfalls, there are no existing data and little or no historical evidence that a release has occurred. For these, the Phase I sampling strategy for OU 1093 will focus on determining the presence or absence of radioactive or hazardous constituents. If constituents are detected at concentrations above conservative screening action levels, a baseline risk assessment may be required, or a VCA may be proposed. If conducted, the baseline risk assessment will be used to determine the need for corrective action. If the data collected during Phase I are not sufficient to support a baseline risk assessment, but indicate the presence of radioactive and/or hazardous constituents above screening action levels, additional RFI Phase II sampling may be undertaken to characterize in more detail the nature and extent of the release.

For the PRSs in OU 1093 that incorporate the abandoned firing sites, there are existing data and/or strong historical evidence to support the hypothesis that a release has occurred. In these cases, the existing information was evaluated to determine whether it is sufficient to support a baseline risk assessment and/or the evaluation of remedial alternatives. Because it was not, Phase I for these sites will collect data focused on performing a screening assessment to determine the possible extent of areas containing potential contaminants at concentrations above screening action levels.

Data quality objectives to support the required decisions are developed for RFI Phase I sampling and analysis plans described in this work plan to ensure that the right type, amount, and quality of data are collected. Field work for many sites includes field surveys, and field or mobile laboratory screening of samples on which the selection of samples for laboratory analysis will be based. Sample analyses will be performed primarily in fixed analytical laboratories.

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

Schedule, Costs, and Reports

The RFI field work described in this document requires 2.7 years to complete. A single phase of field work is expected to be sufficient to complete the RFI for most PRSs; however, a second phase will occur if warranted by the results of the first phase, in which case the field work will take longer than 2.7 years to complete.

Cost estimates for baseline activities to complete the RFI for OU 1093 are provided in Table ES-1. The estimates for costs and schedule are the latest available estimates from the fiscal year 93 baseline request. The data presented are under revision and will be updated as appropriate.

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

- a partial summary of the results of initial site characterization activities;
- vehicles for proposing modifications to the sampling plans suggested by the initial findings;
- work plans that describe the next phase of sampling, when such sampling is required;
- vehicles for recommending VCA or NFA as mechanisms for delisting PRSs shown by the RFI to have acceptable health-based risk levels; and
- summary reports of the sampling plans.

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

TABLE ES-1

ESTIMATED COSTS OF CONDUCTING RFI
OU 1093

Estimate to Complete	$ 9,360,000
Escalation	$ 972,000
Prior Years	$ 712,000
Total at Completion	$11,044,000

Public Involvement

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

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ACRONYMS AND ABBREVIATIONS

AOC	Area of concern
BRET	Biological Resource Evaluation Team
CEARP	Comprehensive Environmental Assessment and Response Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CMS	Corrective measures study
DOE	US Department of Energy
DQO	Data quality objective
EM	Environmental Management (Division)
EM-8	Environmental Protection Group
EPA	US Environmental Protection Agency
ER	Environmental restoration
ES&H	Environment, safety, and health
FAR	Federal acquisition regulation
FIDLER	Field instrument for detection of low-energy radiation
FIMAD	Facility for Information Management, Analysis, and Display
FY	Fiscal year
GPR	Ground-penetrating radar
HE	High explosive
H&S	Health and safety
HS	Health and Safety (Division)
HSE	Health, Safety, and Environment (Division; now EM and HS divisions)
HSWA	Hazardous and Solid Waste Amendments
IS	Information Services (Division)
IWP	Installation work plan
LACEF	Los Alamos Critical Experiment Facility
LANL	Los Alamos National Laboratory
LASL	Los Alamos Scientific Laboratory (LANL before January 1, 1981)
NEPA	National Environmental Policy Act
NESHAP	National emission standards for hazardous air pollutants
NFA	No further action
NMED	New Mexico Environment Department (New Mexico Environmental Improvement Division before 1991)
NPDES	National pollutant discharge elimination system
OSHA	Occupational Safety and Health Administration
OU	Operable unit
OUPL	Operable unit project leader (ER Program)
PCB	Polychlorinated biphenyl
PID	Photoionization detector
PMP	Program management plan
PQL	Practical quantitation limits
QA	Quality assurance
QAMS	Quality assurance management staff (EPA)
QAPjP	Quality assurance project plan

QPP	Quality program plan
QPPL	Quality program project leader
RCRA	Resource Conservation and Recovery Act
RFI	RCRA facility investigation
RPF	Records-Processing Facility
SOP	Standard operating procedure
SPPL	Senior programmatic project leader (ER Program)
SVOC	Semivolatile organic compound
SWMU	Solid waste management unit
TA	Technical area
TNT	Trinitrotoluene
TSD	Treatment, storage, disposal
TTL	Technical team leader (ER Program)
UST	Underground storage tank
VCA	Voluntary corrective action
VOC	Volatile organic compound

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Chapter 1

- Statutory and Regulatory Background
- Installation Work Plan
- Description of OU 1093
- Document Organization

1.0 INTRODUCTION

1.1 Statutory and Regulatory Background

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

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

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

For the purposes of implementing the cleanup process, the Laboratory has aggregated PRSs that are geographically related in groupings called operable units (OUs). The Laboratory has established 24 operable units, and a work plan has been or will be prepared for each. This work plan addresses PRSs located in four of the Laboratory's technical areas (TAs): TAs-18, -27, -36, and -54. This operable unit also contains TA-65, but no PRSs are located in that technical area.

This work plan, together with nine other work plans submitted to EPA in May 1993 and nine work plans submitted in 1990 and 1991, meets the schedule requirements of the HSWA Module, which is to address a cumulative total of 55% of the SWMUs in Table A and a cumulative total of 100% of the 182 priority SWMUs listed in Table B of the HSWA Module.

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

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

1.2 Installation Work Plan

The HSWA Module required that the Laboratory prepare a master plan, the IWP, to describe the Laboratory-wide system for accomplishing all RFIs and corrective measures studies (CMSs). The IWP has been prepared in accordance with the HSWA Module and is consistent with EPA's interim final RFI guidance (EPA 1989, 0088) and proposed Subpart S of 40 CFR 264 (EPA 1990, 0432), which proposes the cleanup program mandated in Section 3004(u) of RCRA. The IWP was first prepared in 1990 and is updated annually. This work plan follows the requirements specified in Revision 2 of the IWP (LANL 1992, 0768).

The IWP describes the aggregation of the Laboratory's PRSs into 24 operable units (Section 3.4.1). It presents a facilities description in Chapter 2 and a description of the structure of the Laboratory's ER Program in Chapter 3. Chapter 4 describes the technical approach to corrective action at the Laboratory. Annexes I-V of the IWP contain the Program Management Plan, Quality Program Plan, Health and Safety Program Plan, Records Management Program Plan, and the Community Relations Program Plan, respectively. The document also contains a proposal to integrate RCRA closure and corrective action and a strategy for identifying and implementing interim remedial measures. When information relevant to this work plan has already been provided in the IWP, the reader is referred to the 1992 revision of the IWP.

1.3 Description of OU 1093

OU 1093 is located in Los Alamos County in north-central New Mexico (Figure 1-1). This operable unit encompasses four of the current or formerly designated Laboratory technical areas [TAs-18, -27 (former), -36, and -65]. In addition, three AOCs included in this operable unit are located within the boundaries of TA-54, even though TA-54 is the responsibility of OU 1148. Numerical designations for the PRSs in this operable unit correspond to the technical area in which they were located at the time of their operation.

TABLE 1-1

RFI GUIDANCE FROM THE HSWA MODULE

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

*RI/FS - remedial investigation/feasibility study.

TABLE 1-2

LOCATION OF HSWA MODULE REQUIREMENTS IN ER PROGRAM DOCUMENTS

HSWA MODULE REQUIREMENTS OR RFI WORK PLANS	INSTALLATION WORK PLAN AND OTHER PROGRAM DOCUMENTS	DOCUMENTS FOR OU 1093
Task I: Description of Current Conditions		
A. Facility Background	IWP Section 2.1	
B. Nature and Extent of Contamination	IWP Section 2.4 and Appendix F	
Task II: RFI Work Plan		
A. Data Collection Quality Assurance Plan	IWP Annex II (Quality Program Plan)*	RFI Work Plan Annex II
B. Data Management Plan	IWP Annex IV (Records Management Program Plan)	RFI Work Plan Annex IV
C. Health and Safety Plan	IWP Annex III (Health and Safety Program Plan)	RFI Work Plan Annex III
D. Community Relations Plan	IWP Annex V (Community Relations Program Plan)	RFI Work Plan Annex V
E. Project Management Plan	IWP Annex I (Program Management Plan)	RFI Work Plan Annex I
Task III: Facility Investigation		
A. Environmental Setting	IWP Chapter 2	RFI Work Plan Chapter 3
B. Source Characterization	IWP Appendix F	RFI Work Plan Chapter 5
C. Contamination Characterization	IWP Appendix F	RFI Work Plan Chapters 4 and 5
D. Potential Receptor Identification	IWP Section 4.2	RFI Work Plan Chapters 4 and 5
Task IV: Investigative Analysis		
A. Data Analysis	IWP Section 4.2	Phase Report and RFI Report
B. Protection Standards	IWP Section 4.2	RFI Report
Task V: Reports		
A. Preliminary and Work Plan	IWP, Rev. 0	Work Plan
B. Progress	Monthly Reports, Quarterly Reports, and Annual Revisions of IWP	Phase Reports
C. Draft and Final		Draft and Final RFI Report

* Annex II of the IWP addresses these requirements by reference to controlled documents: the generic Quality Assurance Project Plan (LANL 1991, 0412) and the ER Program's standard operating procedures (LANL 1991, 0411).

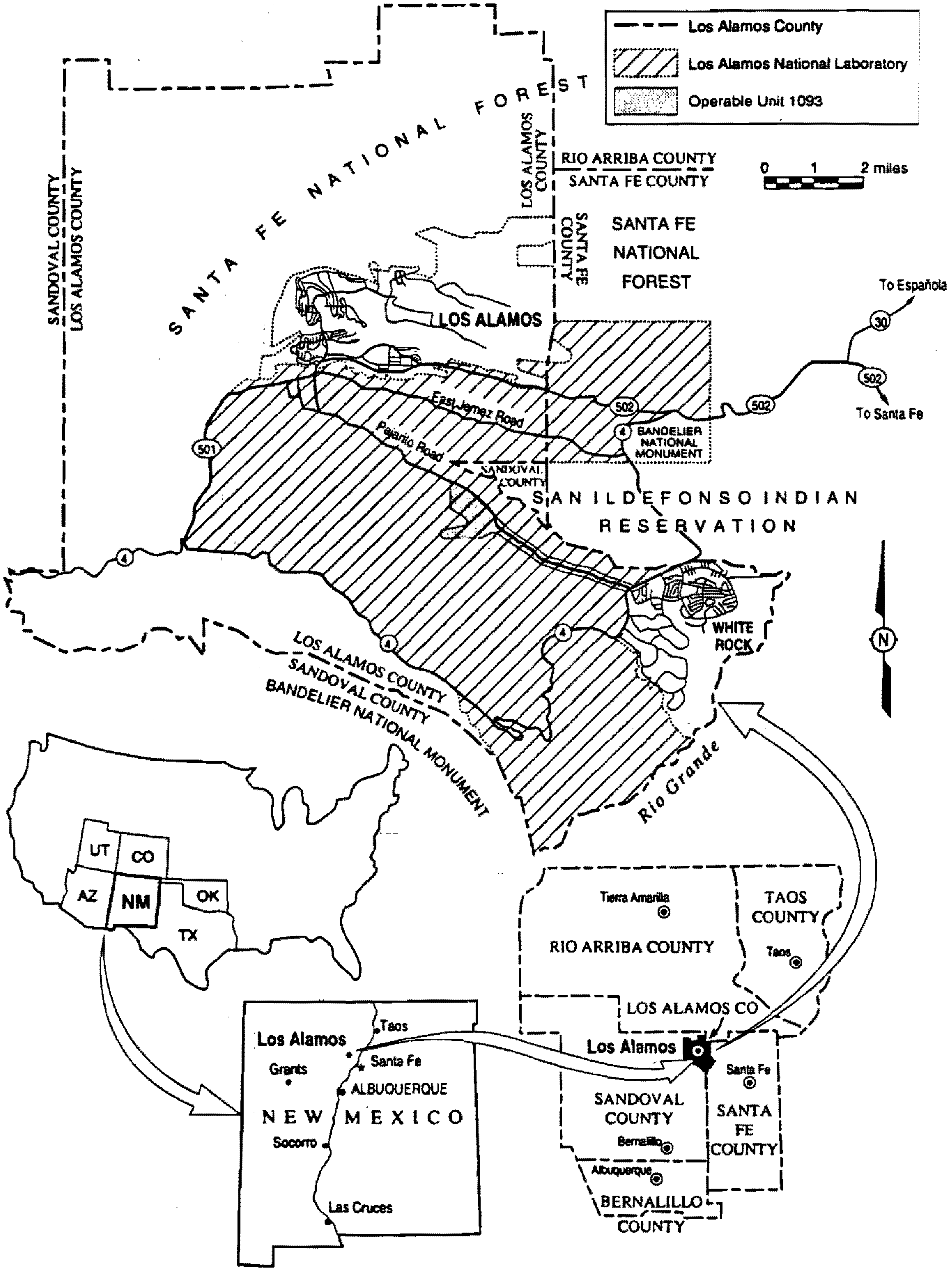

Figure 1-1. Location of Operable Unit 1093.

The SWMUs and AOCs in OU 1093 are located on property owned by the US Government and operated for the Department of Energy by the University of California.

There are a total of 45 PRSs previously identified in OU 1093 (LANL 1990, 0145) and, in the course of archival data review, one possible addition to that list was identified. The locations of these 45 PRSs are illustrated in Figures 1-2 (TA-18), 1-3 (TA-54), and 1-4 (TAs-27 and -36). Table 1-3 of this work plan lists all PRSs included in OU 1093, identifies those which are included in Table A of the HSWA Module, and locates the discussion of each PRS in either this or another work plan. Fourteen of these PRSs are being proposed for no further action (NFA) or deferred action (Table 1-4). None of these 14 PRSs are listed in the current HSWA permit. RFI field work is proposed for 32 PRSs (31 former plus one possible addition). Of these, 21 are listed in Table A of the HSWA Module; each of these is therefore designated as a SWMU. Of the remaining 11 for which field work is proposed, four [18-004(a), and 18-012(a-c)] satisfy the definition of a SWMU (Section 1.1) and are so designated. The other seven are designated as AOCs in this work plan. DOE and the Laboratory have elected to include AOCs in the RFI work plan and in the RFI as a means of establishing what, if any, further investigation or cleanup may be required. The PRSs for which RFI field work is proposed were aggregated into groups as a function of common characteristics: waste or contaminant types present, the nature of the PRS, or the types of operations associated with the PRSs. The PRS aggregates identified in this work plan consist of liquid waste management systems, an underground storage tank, firing sites and associated structures, storm sewer outfalls, and a materials disposal area and a bazooka impact area. The PRSs were not aggregated on the basis of physical proximity, although because of the relatively small size of OU 1093, many PRSs in a particular aggregate are in close proximity to one another.

Section 3.5.2.6 of the IWP states that each work plan may contain an application for a Class III permit to modify Table A of the HSWA Module when it is determined that a SWMU needs no further investigation or when it is necessary to add SWMUs to the current listing (LANL 1992, 0768). However, none of the PRSs proposed for NFA in this work plan (Table 1-4) are listed in the HSWA Module. Following field investigations, proposals for NFA for sites listed in the HSWA Module will be implemented by proposing permit modifications.

1.4 Organization of This Work Plan and Other Useful Information

This work plan follows the generic outline provided in Table 3-2 of the IWP (LANL 1992, 0768). Following this introductory chapter, Chapter 2 provides background information on OU 1093, which includes a description and history of the operable unit, a description of past waste management practices, and current conditions at technical areas in the operable unit.

Chapter 3 describes the environmental setting, and Chapter 4 presents the technical approach to the field investigation. Chapter 5 contains an evaluation of all the PRSs in OU 1093 for which RFI field work is proposed, and includes a description and history of each PRS, a conceptual exposure model, remediation alternatives and evaluation criteria, data needs and data quality objectives, and a

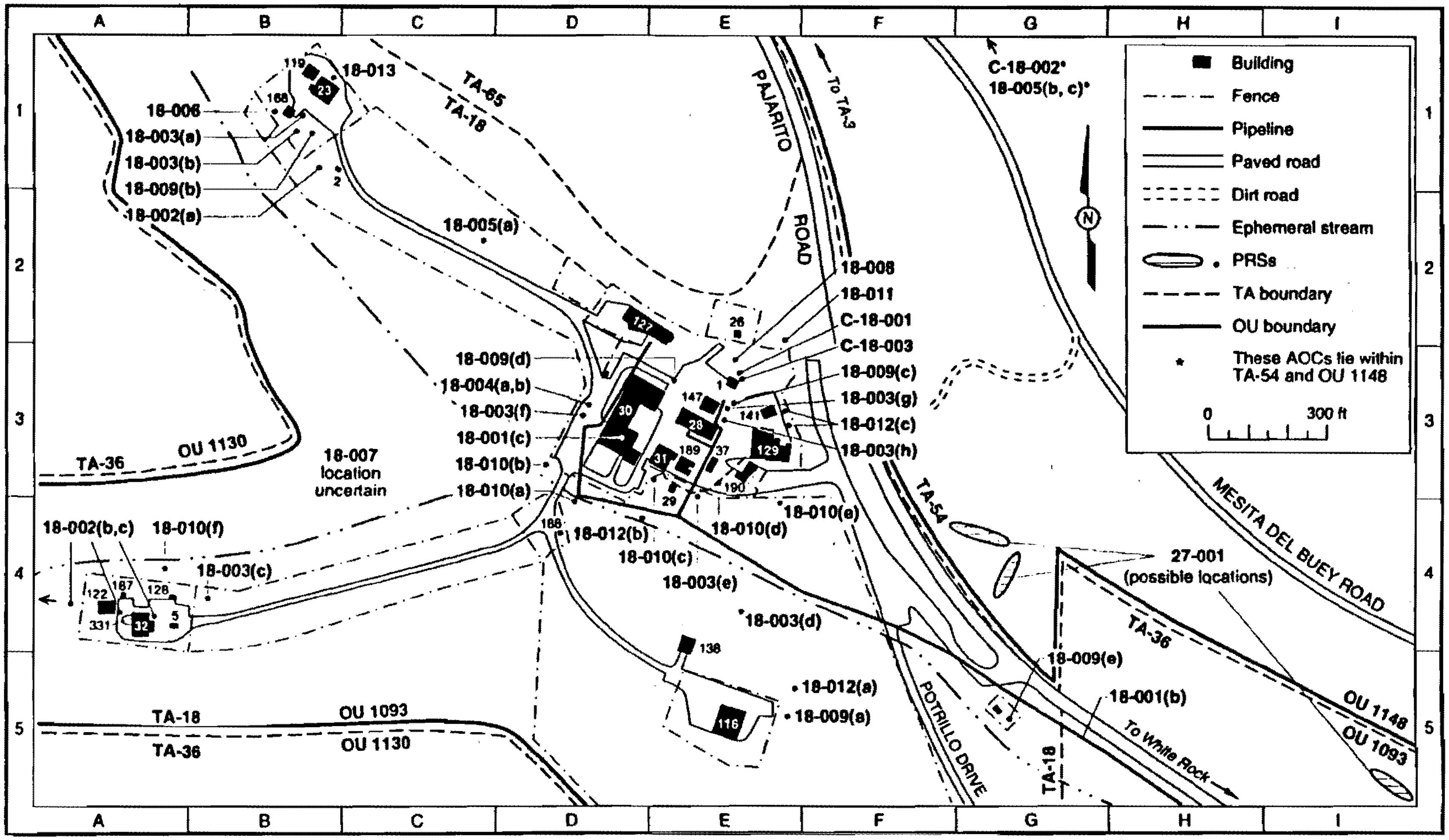

Figure 1-2. Location of PRSs at TA-18 and former TA-27.

Source: LANL, 1989, ENG-R5112, Sh.1

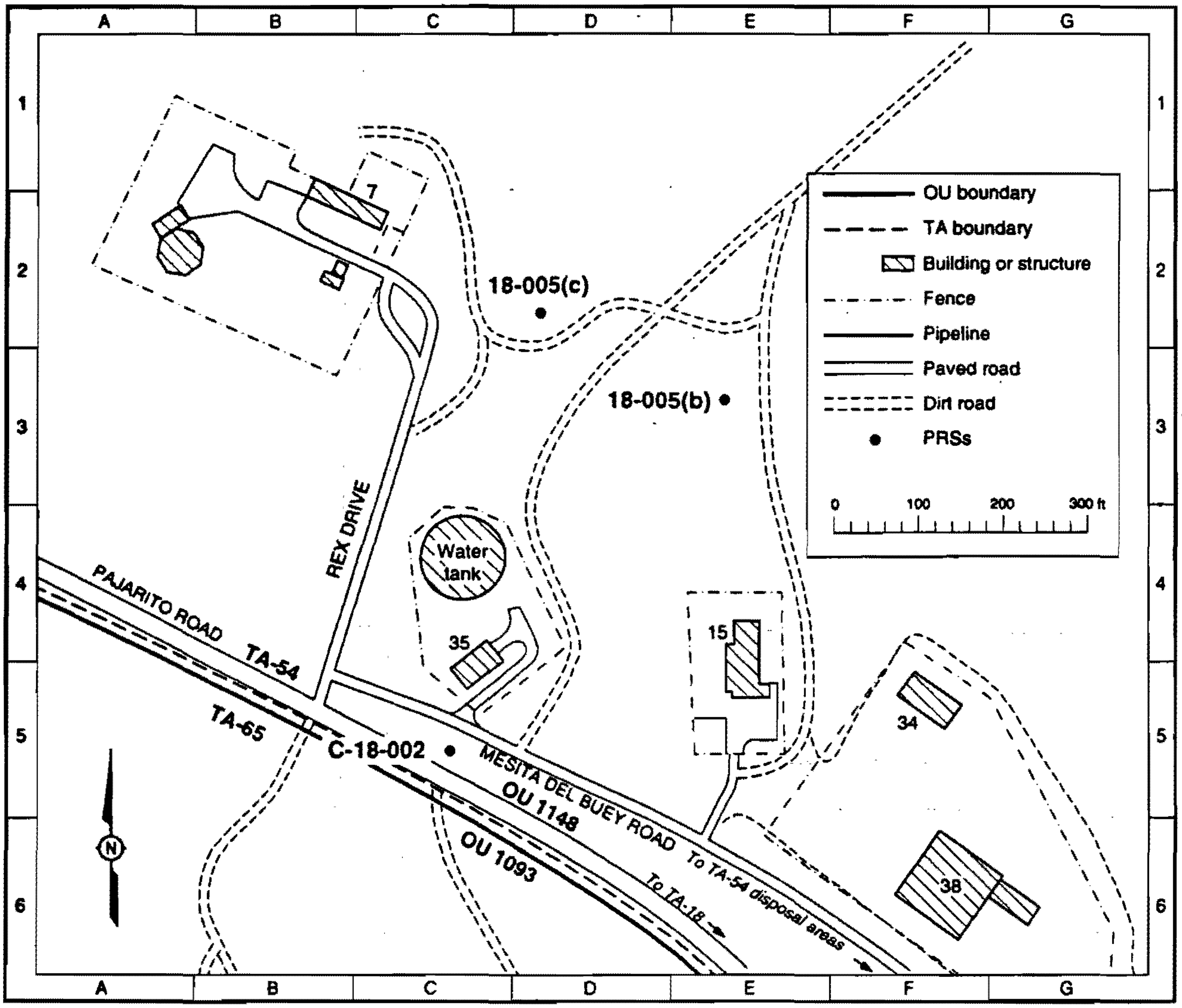

Figure 1-3. Location of OU 1093 PRSs within TA-54 (OU 1148).

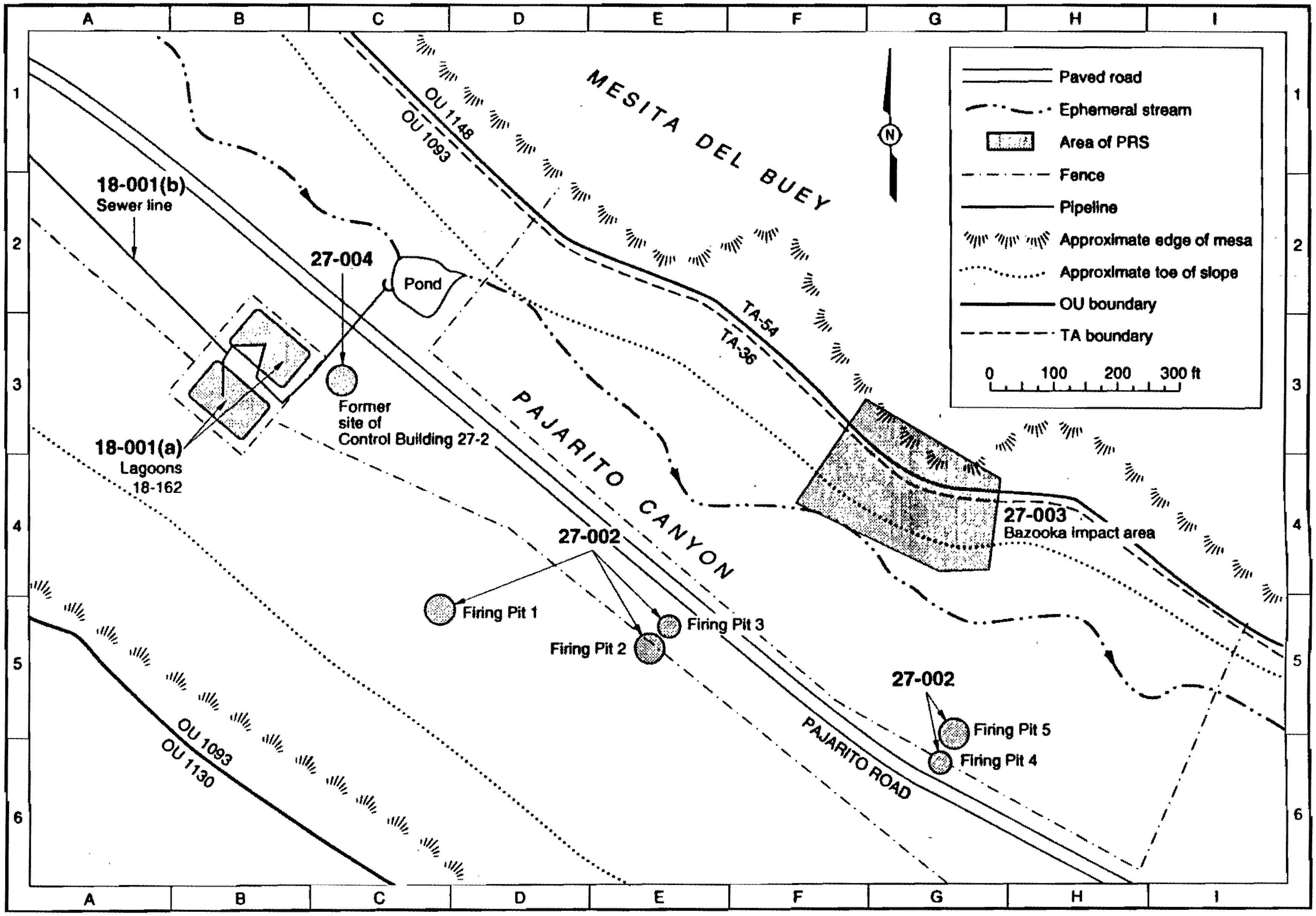

Figure 1-4. Location of PRSs at former TA-27.

TABLE 1-3
POTENTIAL RELEASE SITES IDENTIFIED IN OU 1093

PRS No.	Description/Location	SWMUs listed in Table A of HSWA Module	Location of Discussion[b]		Figure Location	
			Description	Sampling Plan	Fig. No.	Grid
18-001	**Lagoons and drain lines**					
18-001(a)	Lagoons	X	5.1.1.1	5.1.5.1	1-4	B-3
18-001(b)	Sanitary sewer lines	X	5.1.1.1	5.1.5.1	1-2	G-5
18-001(c)	Bldg. 18-30 sump	X	5.1.1.4.2	5.1.5.4.1	1-2	D-3
18-002	**Firing sites**					
18-002(a)	Pajarito Canyon	X	5.3.1.1.1	5.3.5.1	1-2	B-1
18-002(b)	Threemile Canyon	X	5.3.1.1.3	5.3.5.1	1-2	A-4
18-002(c)	Drop tower		5.3.1.1.3	5.3.5.1	1-2	A-4
18-003	**Septic systems/settling pits[a]**					
18-003(a)	Industrial waste; Kiva 1	X	5.1.1.2.1	5.1.5.2	1-2	B-1
18-003(b)	Sanitary waste; Kiva 1	X	5.1.1.2.2	5.1.5.2	1-2	B-1
18-003(c)	Kiva 2	X	5.1.1.2.3	5.1.5.2	1-2	B-4
18-003(d)	Kiva 3	X	5.1.1.2.4	5.1.5.2	1-2	E-4
18-003(e)	Bldgs. 18-31, 18-37, and 18-129	X	5.1.1.2.5	5.1.5.2	1-2	E-3
18-003(f)	Sanitary waste—Bldg. 18-30	X	5.1.1.2.6	5.1.5.2	1-2	D-3
18-003(g)	Bldg. 18-1	X	5.1.1.2.7	5.1.5.2	1-2	E-3
18-003(h)	Bldg. 18-147	X	5.1.1.2.8	5.1.5.2	1-2	E-3
18-004	**Rad waste collection system**					
18-004(a)	Waste line for Bldg. 18-30		5.1.1.3	5.1.5.3	1-2	D-3
18-004(b)	Collection tanks	X	5.1.1.3	5.1.5.3	1-2	D-3
18-005	**Magazine sites**					
18-005(a)	Pajarito Canyon—Bldg. 18-15	X	5.3.1.1.2	5.3.5.2	1-2	C-2
18-005(b)	Mesita del Buey—Bldg. 18-11	X	6.6 (OU 1148)[c]	NFA	1-3	E-3
18-005(c)	Mesita del Buey—Bldg. 18-12	X	6.6 (OU 1148)[c]	NFA	1-3	D-2
18-006	Uranium solution pipe—Bldg. 18-168		6.3.1	6.3.2 (NFA)	1-2	B-1
18-007	Buried military tank	X	5.5.1.3	5.5.5.3	1-2	uncertain
18-008	Underground storage tank 18-104		5.2.1	5.2.5	1-2	E-3
18-009	**PCB transformers**					
18-009(a)	18-136, adjacent to Bldg. 18-116		6.2.1.1	6.2.1.2 (NFA)	1-2	E-5
18-009(b)	18-46, adjacent to Bldg. 18-23		6.2.2.1	6.2.2.2 (NFA)	1-2	B-1
18-009(c)	18-48, adjacent to Bldg. 18-1		6.2.2.1	6.2.2.2 (NFA)	1-2	E-3
18-009(d)	18-142, adjacent to Bldg. 18-30		6.2.3.1	6.2.3.2 (NFA)	1-2	E-3
18-009(e)	Capacitor—Bldg. 18-252		6.2.4.1	6.2.4.2 (NFA)	1-2	G-5
18-010	**Storm sewer outfalls**					
18-010(a)	Roof drains—Bldg. 18-30		6.2.5.1	6.2.5.2 (NFA)	1-2	D-4
18-010(b)	Drainage ditch west of Bldg. 18-30		5.4.1.1	5.4.5.1	1-2	D-3
18-010(c)	Paved area drainage—Bldg. 18-30		5.4.1.2	5.4.5.1	1-2	E-3
18-010(d)	Paved area NE of Bldg. 18-37		5.4.1.3	5.4.5.1	1-2	E-3
18-010(e)	Paved area, Bldgs. 18-28, 18-147		5.4.1.4	5.4.5.1	1-2	E-3
18-010(f)	Roof and floor drains, Kiva 2		5.4.1.5	5.4.5.1	1-2	A-4
18-011	Soil near former Bldg. 18-22		5.3.1.1.3	5.3.5.2	1-2	E-3
18-012	**Sumps and drains**					
18-012(a)	Drain line and outfall—Kiva 3		5.1.1.4.1	5.1.5.4.2	1-2	E-5
18-012(b)	Outfall for Bldg. 18-30, 18-31		5.1.1.4.2	5.1.5.4.1	1-2	D-4
18-012(c)	Sump and drains—Bldg. 18-141		5.1.1.4.3	5.1.5.4.2	1-2	E-3
18-012(d)	Unidentified drain E. of 18-129		6.2.6.1	6.2.6.2 (NFA)	NA	
18-013	Special waste catch tank		5.1.1.4.4	5.1.5.4.3	1-2	B-1
C-18-001	Photochemical laboratory, Bldg. 18-1		6.2.8.1	6.2.8.2 (NFA)	1-2	E-3
C-18-002	Assembly Bldg. 18-10 in TA-54		6.2.9.1	6.2.9.2 (NFA)	1-3	C-5
C-18-003	Radioactive waste storage area	X	6.2.10.1	6.2.10.2 (NFA)	1-2	E-3
27-001	Burial trench	X	5.5.1.1	5.5.5	1-2	H-4
27-002	Five firing sites at TA-27	X	5.3.1.1.4	5.3.5.1	1-4	C/G-5/6
27-003	Bazooka impact area		5.5.1.2	5.5.5	1-4	G-4
27-004	Control Bldg. 27-2		6.2.7.1	6.2.7.2 (NFA)	1-4	C-3

a. Assumed to be combined sanitary and industrial waste, except as noted.

b. Section numbers in this report, except as noted.

NA. PRS could not be located.

c. RFI Work plan for OU 1148 (LANL 1992, 0788).

TABLE 1-4

PRSs PROPOSED FOR NO FURTHER ACTION OR DEFERRED INVESTIGATION

PRS No.	Description
18-005(b)	Magazine, Building TA-18-11
18-005(c)	Magazine, Building TA-18-12
18-006[a]	Uranium solution pipe
18-009(a)	PCB transformer
18-009(b)	PCB transformer
18-009(c)	PCB transformer
18-009(d)	PCB transformer
18-009(e)	PCB transformer
18-010(a)	Storm sewer
18-012(d)	Unidentified drains
C-18-001	Photochemical laboratory
C-18-002	Assembly building
C-18-003	Radioactive waste storage area
27-004	Control building

a. RFI work plan for OU 1148 (LANL 1992, 0788).
b. Proposed for deferred action.

sampling plan. Chapter 6 of this work plan provides a brief description of each PRS proposed for no further action or deferred investigation and the basis for that recommendation.

The body of the text is followed by five annexes, which consist of project plans corresponding to the program plans in the IWP: project management, quality assurance, health and safety, records management, and community relations. Appendix A contains a list of contributors to this work plan. Appendix B contains the list of screening action levels that provide the criteria for proposing no further action for sites investigated under Phase I of the RFI.

The units of measurement used in this document are expressed in both English and metric units, depending on which unit is commonly used in the field being discussed. For example, English units are used in text pertaining to engineering, and metric units are often used in discussions of geology and hydrology. When information is derived from some other published report, the units are consistent with those used in that report. A conversion table is provided at the end of this work plan.

A list of acronyms precedes Chapter 1. A glossary of unfamiliar terms is provided in the IWP (LANL 1992, 0768).

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- OU 1093 Description
- TA-27—Gamma Site
- TA-36 Fragment Impact Circle
- TA-18—Pajarito Site
- TA-65

2.0 BACKGROUND INFORMATION FOR OU 1093

This chapter provides background information related to the historical operations of Operable Unit (OU) 1093, which consists of Technical Areas (TAs) 65, 18, 27, and parts of 36 and 54. Programmatic activities are described from the earliest-known Laboratory activity to the present. Structures and their locations are described, with emphasis on structures related to the PRSs addressed in Chapters 5 and 6 of this work plan.

2.1 OU 1093 Description

OU 1093 consists of the portion of Pajarito Canyon from just west of TA-18, eastward 3.5 miles to State Road 4 at White Rock, New Mexico (Figure 2-1). The boundaries of OU 1093 lie primarily within the canyon, from the steep cliffs on the north to the top of the low mesa on the south. It includes the eastern part of Threemile Canyon where it joins Pajarito Canyon at TA-18. East-flowing creeks exist in both canyons. Upstream from TA-18, the flow in a portion of Pajarito Canyon is perennial and flow in Threemile Canyon is supported by ephemeral groundwater discharge within and upstream from TA-18. The creeks flow only during periods of sustained snowmelt or following heavy rainstorms.

One former technical area and four presently designated technical areas lie within OU 1093. From west to east they are (1) TA-65, the small triangular area south of Pajarito Road on the north canyon rim above TA-18; (2) TA-18, located in Pajarito and Threemile canyons near the west end of the operable unit; (3) a small portion of TA-54 that lies just east of TA-18 within Pajarito Canyon; (4) TA-36, the portion of the operable unit east of TA-18; and (5) former TA-27 (presently within TA-36) in the center of the operable unit (Figure 2-1).

TA-36 lies primarily within OU 1130. Its operations and facilities will be discussed in the OU 1130 work plan. Only areas physically within OU 1093 are discussed in this work plan.

2.2 TA-27 - Gamma Site

2.2.1 Site History

Located in the center of OU 1093, this site served as TA-18's third firing site, called Far Point; the other two firing sites were within the present boundaries of TA-18 (Section 2.4). Established during the Manhattan Project in late 1944, Far Point was used by Group G-3 for full-scale tests of implosion weapon designs that required larger charges of high explosives (HE) than could be fired at the other two firing sites.

In late 1945, the site was upgraded with several structures from TA-18 and became known as Gamma Site, later redesignated TA-27. From west-to-east, the site's structures consisted of two small concrete control bunkers covered by earthen berms, a boardwalk, a series of instrumented manholes, and five round firing pits (Figure 1-4).

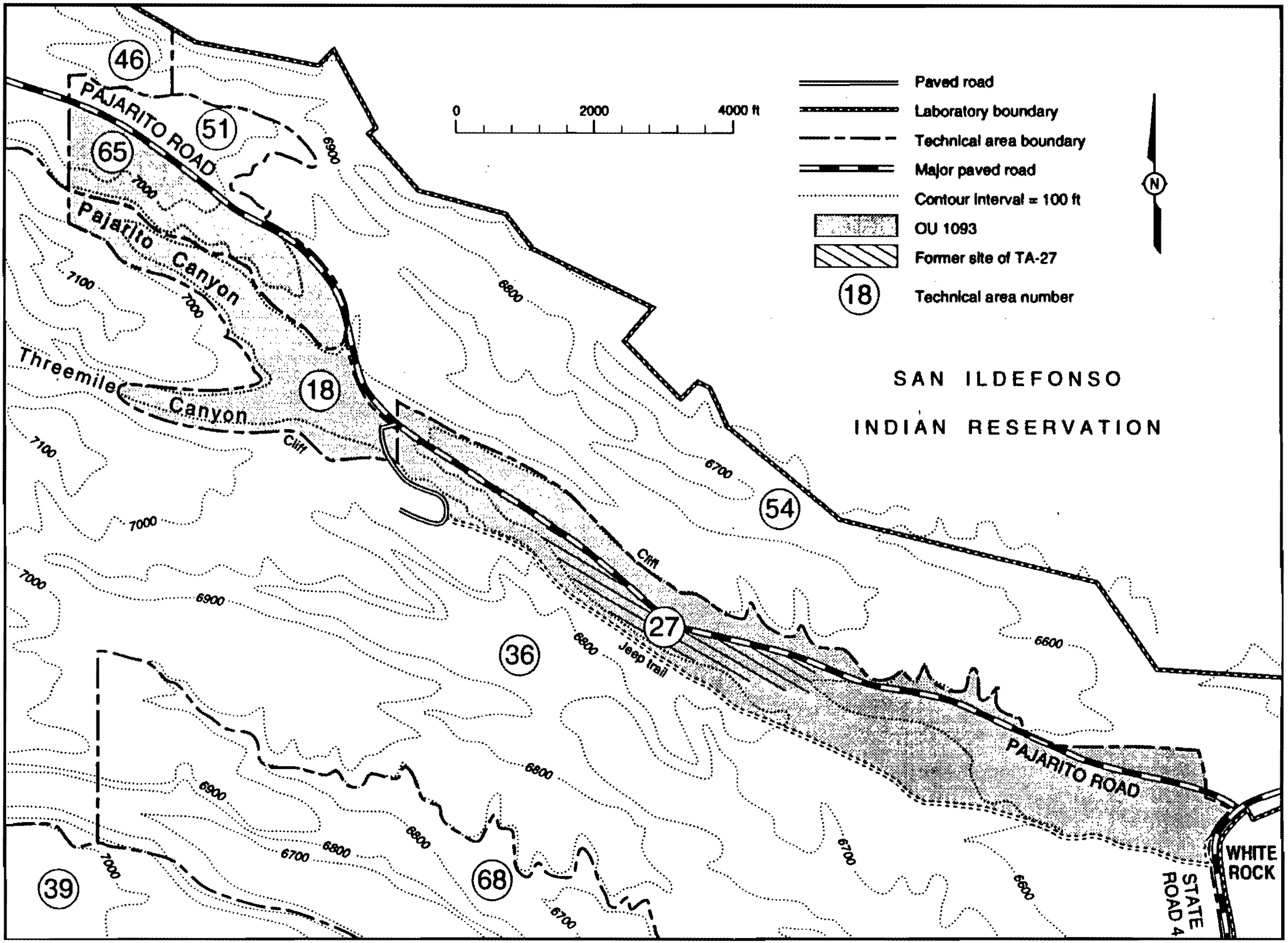


Figure 2-1. Technical areas within and surrounding OU 1093.

Shots fired at Gamma Site contained up to 2 tons of HE and utilized materials such as thorium, depleted uranium, and beryllium. In 1946, a bullet sensitivity test was conducted at Firing Pit 1 in which a 0.50-caliber machine gun was fired at a block of Composition B explosive. The block underwent a low-order explosion (i.e., the shot did not detonate completely) scattering undetonated HE up to 250 yards (LANL 1990, 0145).

The 1945 site upgrade included improving the access road from TA-18 with a layer of gravel. A faint trace of this early road can be seen south of present-day Pajarito Road. The entire site was abandoned and fenced off in early 1947. Excavation of gravel for road material was done between 1949 and 1962 throughout the length of Pajarito Canyon east of TA-18, even within TA-27.

The area was reopened in March 1960 to begin construction of a road to White Rock. The gravel road from TA-18 was shifted north, bisecting the old firing site. It was widened, paved, and opened to the public as Pajarito Road on July 11, 1962. An incident involving unexploded Army ordnance from a hillside north of TA-27 occurred at that time. Civilians entered the area before it was refenced and removed a dud bazooka round, which later exploded amid a group of children who were playing with it in Los Alamos (Brawley et al. 1962, 16-0057).

During the 1960s, all structures, concrete foundations, and other debris were removed and the ground surface was leveled. About 1969, the sanitary sewage lagoons and sewer line from TA-18 were built, the last major site activity. The sites of all former structures have been located in relation to present-day Pajarito Road. Firing Pits 4 and 5 were north of the road; all other structures were south of it. Only Firing Pit 4 has any surface expression; the other firing pits are buried (the material within and around Firing Pit 5 may have been removed during excavations for road gravel).

2.2.2 Current Activities at TA-27

No Laboratory operations have taken place at this former site since 1947. It is presently within the fragment impact circle of TA-36's Firing Site 12, commonly referred to as Lower Slobbovia, and is potentially affected by operations there.

2.3 TA-36 Fragment Impact Circle

Part of OU 1093, particularly the area lying within former TA-27, is within the 900-m fragment impact circle designated for Lower Slobbovia. The fragment impact circle also includes part of OU 1148 (within TA-54) to the north of TA-36. Fragments from decades of firing at TA-36 and/or former TA-27 can be found within OU 1093. In July 1992, for example, a crew inspecting a power line route east of TA-27 near Building TA-36-136 found fragments of aluminum with minor radioactivity from uranium contamination (LANL 1992, 16-0026).

2.4 TA-18 - Pajarito Site

2.4.1 Site History

Pajarito Site is located at a fork in Pajarito Canyon where Threemile Canyon enters from the southwest (Figure 2-2). This site was the location of a former dude ranch, the Pajarito Club, built by Ashley Pond in 1914 and later abandoned. An earlier log homestead remains. The site was first developed in August 1943 during the Manhattan Project by Group P-5, the Radioactivity Group, to study rates of spontaneous fission from samples of radioactive materials.

In 1944, Group G-3 took over the site (named Pajarito Canyon Laboratory), enlarged it, and used it as a proving ground to study implosions. Three firing sites were constructed: a small firing site in Pajarito Canyon for experiments involving small explosive charges of a few pounds (Figure 2-3); a second one, called medium firing site, in Threemile Canyon for charges of several hundred pounds (Figure 2-4); and a third, located about a mile to the east of TA-18 at the end of a narrow unimproved road, for testing charges of up to 2 tons (Figure 1-4). (Locations of the areas illustrated in Figures 2-3 through -10 are shown in Figure 2-2.) Each site consisted of one or more firing locations and aboveground bunkers reinforced with steel plate, referred to as "battleships." The third site, known as Far Point, was later incorporated into Gamma Site, later redesignated TA-27 (Section 2.2). A magazine (TA-18-15) and a trimming building (TA-18-19) were constructed east of the small firing site (Figure 2-3). Of the three firing site structures, only the two battleships remain. The central area at TA-18 originally consisted primarily of Building TA-18-1, which contained an electronics laboratory, shop, and photochemical laboratory (Figure 2-5).

Two additional magazines (TA-18-11 and -12) and an explosives assembly building (TA-18-10) were built north of Pajarito Road on the mesa above the site (Figure 2-6). These three structures, now removed, were within present-day TA-54, outside the boundary of OU 1093. The SWMU Report (LANL 1990, 0145) incorrectly lists them in TA-51. A lumber storage building (TA-18-13) and a carpentry shop (TA-18-14) were located south of Pajarito Road on the mesa above TA-18 (now in newly designated TA-65) between Pajarito Road and the north rim of Pajarito Canyon. Building TA-18-14 was later used as a radiation counting laboratory.

Explosives testing by G-Division ended in late 1945. In April 1946, the site was transferred to Group M-2, the Critical Assemblies Group. Since that time, TA-18's history has revolved around critical assembly work.

A 1946 fatal incident involving a hands-on criticality experiment, following a similar fatality in 1945, caused an immediate shutdown of manual criticality operations and indicated the urgent need for remotely controlled operation of such experiments. Kiva 1 (TA-18-23), an important addition to the site, was built in 1947 at the former small firing site. The 0.25-mile separation from its new control room in the east end of Building TA-18-1 provided a safe working distance from which to operate critical assemblies. An electrical generator building (TA-18-22) was also added at the northeast corner of the site, but it was removed in 1950.

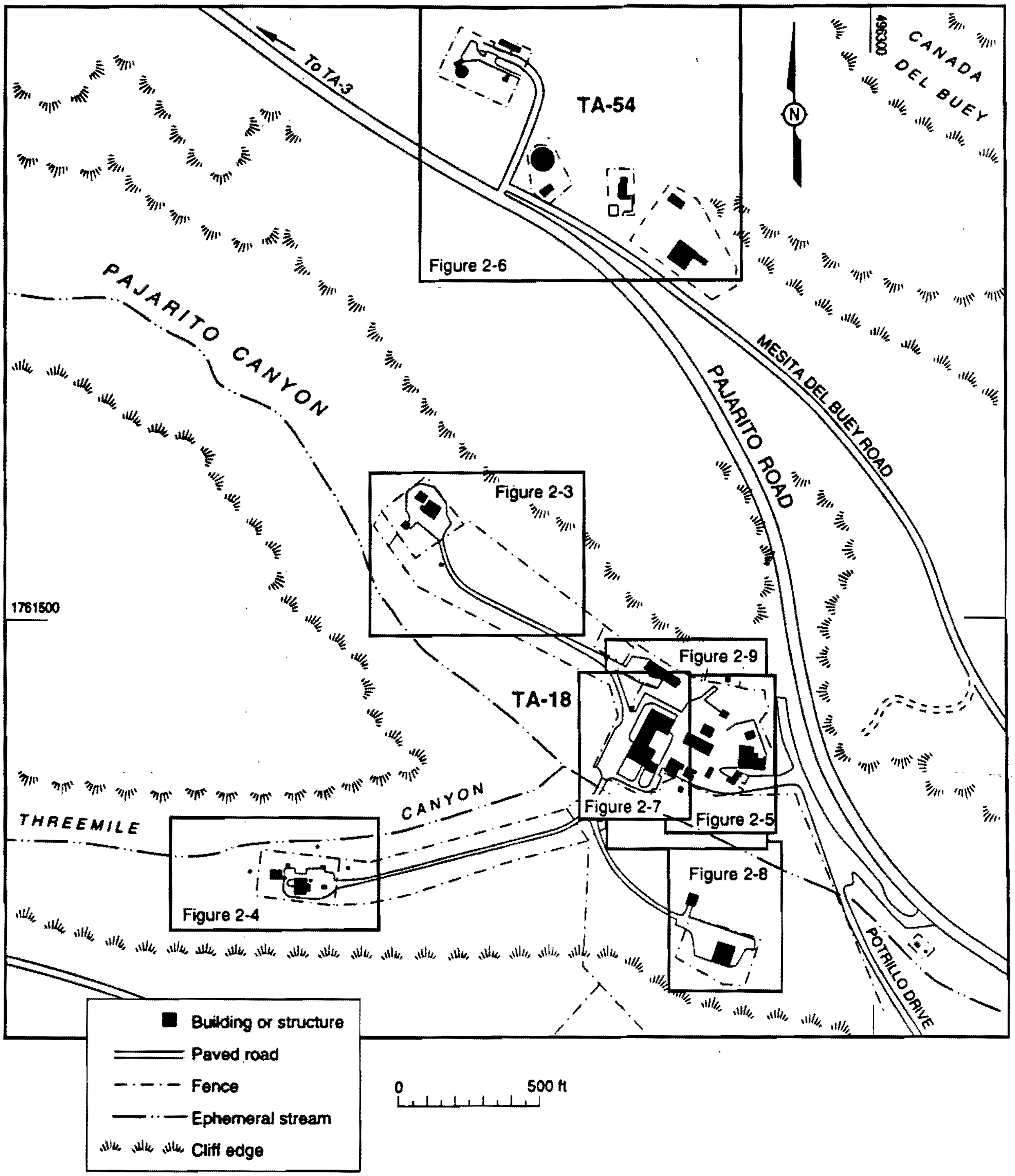


Figure 2-2. Index map for Figures 2-3 through 2-10.

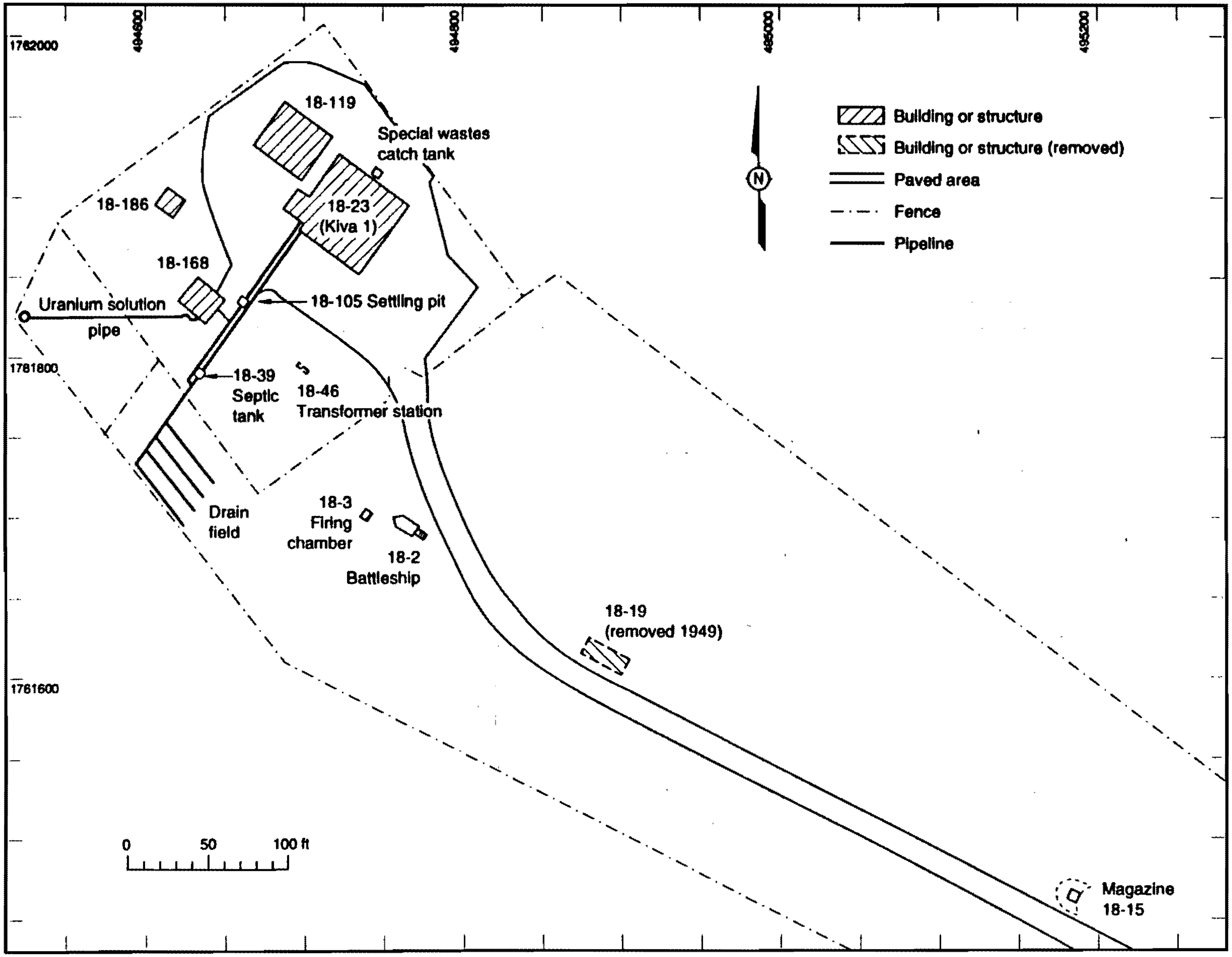


Figure 2-3. Site features adjacent to Kiva 1, TA-18.

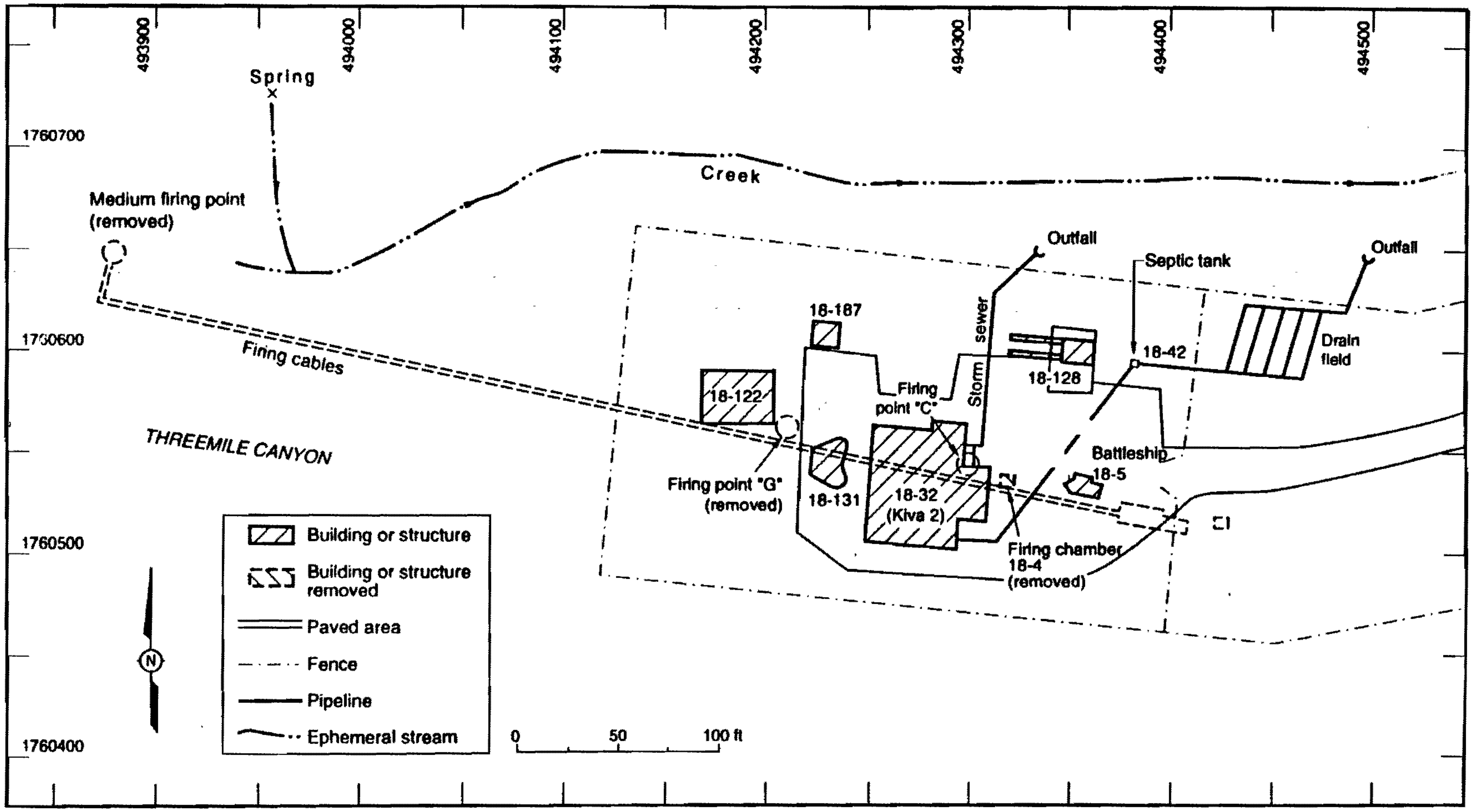


Figure 2-4. Site features adjacent to Kiva 2, TA-18.

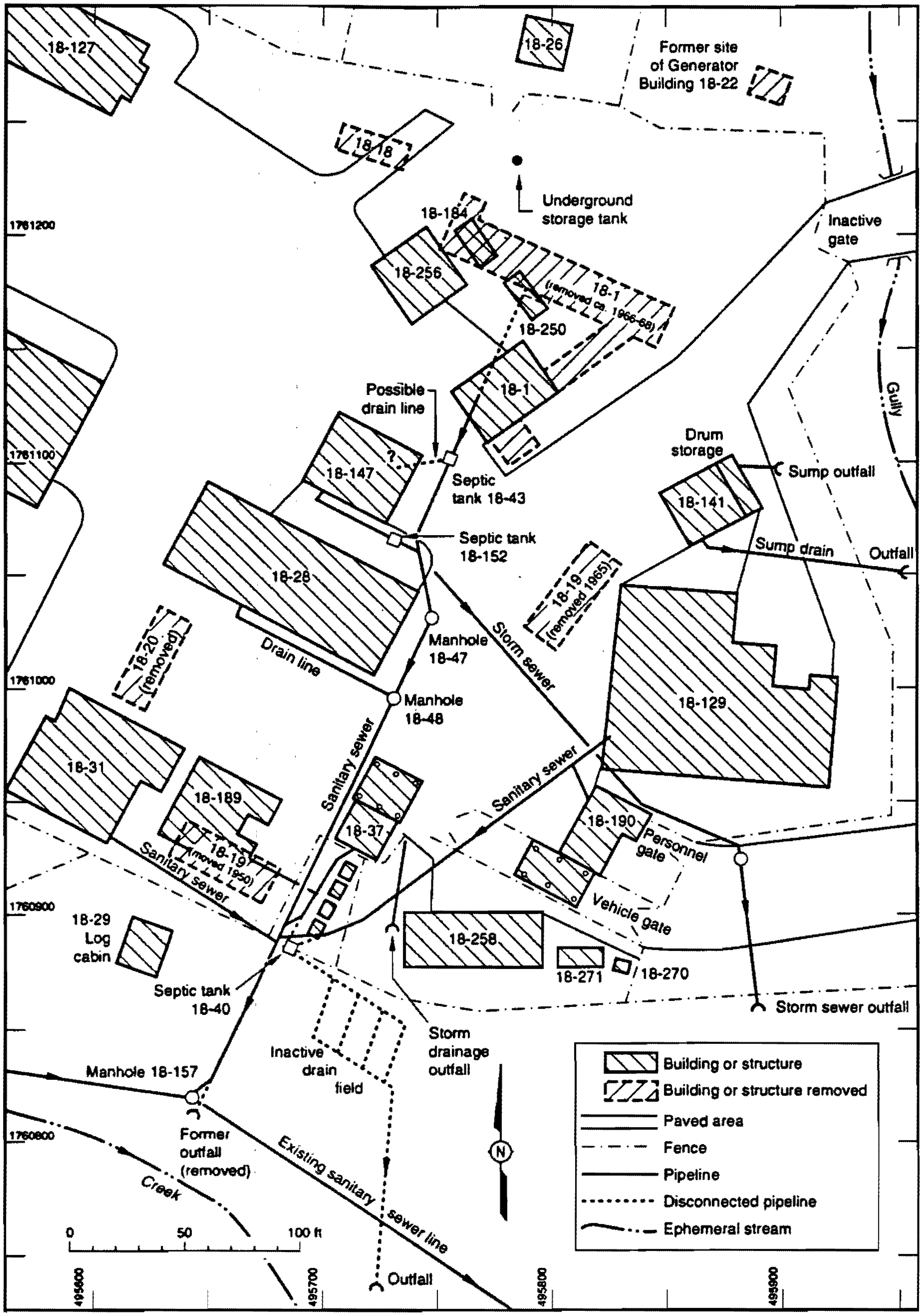


Figure 2-5. Structures and drain systems in central TA-18 area.

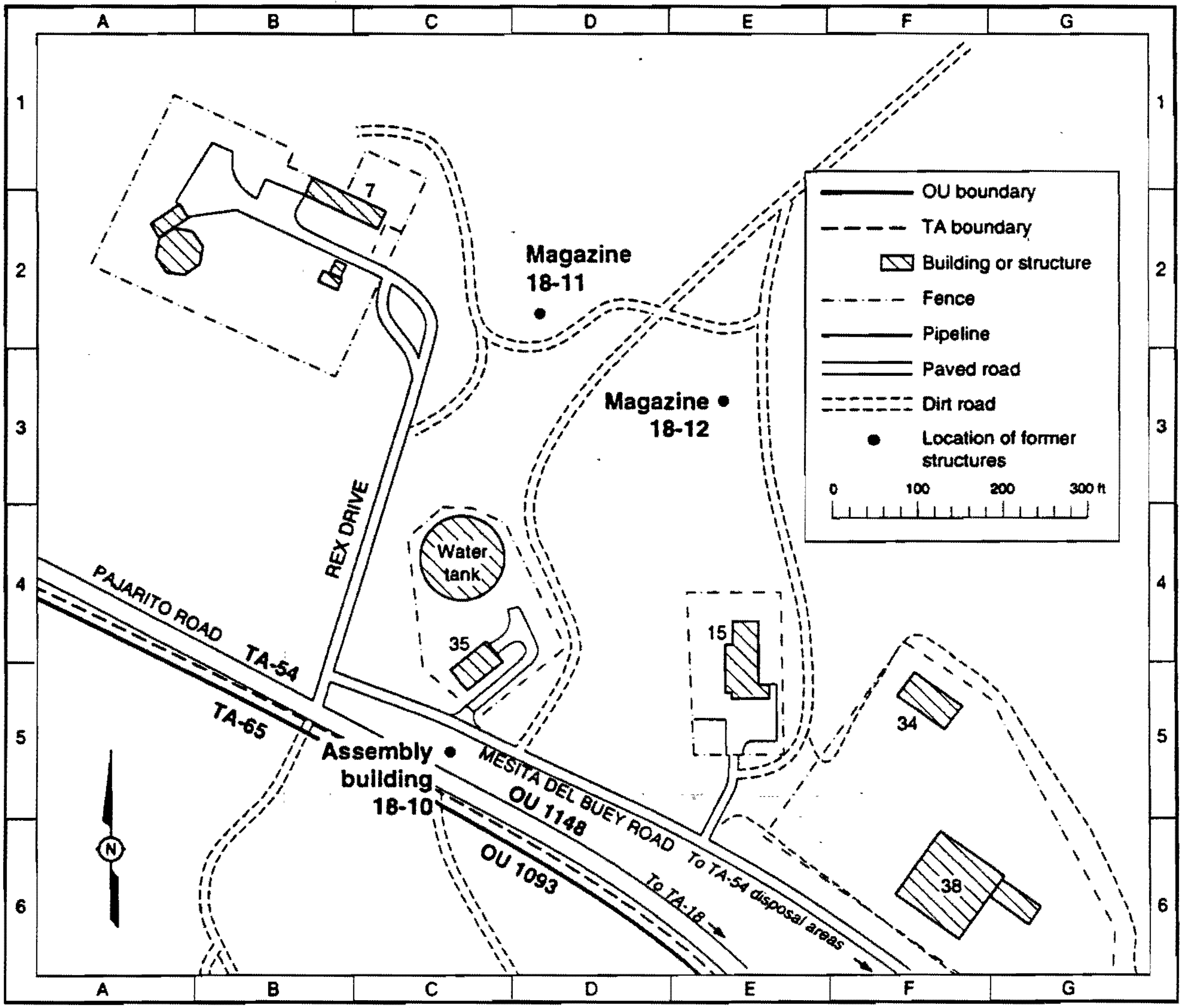


Figure 2-6. Former magazines and assembly building in TA-54 (OU 1148).

The workload expansion at Pajarito Canyon Laboratory required the addition of an office building, TA-18-30, and a second Kiva, TA-18-32, in 1951. All control rooms were placed in Building TA-18-30. Buildings TA-18-28, -31, and -37 were constructed between 1949 and 1951. Kiva 3 (TA-18-116) was added in 1960.

From 1955 to 1972, fission reactor mockup studies for the Rover Program, a nuclear rocket propulsion program, were also conducted at TA-18 using the remotely controlled kivas. The completion of Kiva 3 allowed the uranium reactor mockup tests to be moved from Kiva 1 to Kiva 3. Zero-power mockups remained in Kiva 1 and non-Rover critical assembly work was done in Kiva 2. Reactor mockups consisted of various geometries and utilized materials such as deuterium oxide, uranium carbide, enriched uranium, graphite, niobium, and zirconium hydride (Paxton 1978, 16-0006). Beryllium oxide was also used in some mockups.

Termination of the Rover Program in 1973 resulted in a major downsizing and reorganization of TA-18 personnel. The work shifted to mockups of a plasma-core power reactor, which used fuel elements and beryllium (components left over from the Rover Program), enriched uranium foils, and uranium hexafluoride gas. Criticality work involving reactor safety and, later, nuclear detection technologie, continued under various other groups.

During the 1970s and 1980s, Buildings TA-18-186, -187, -188, -189, -227, -256, -257, and -258 were added. TA-18's facilities and expertise in critical assemblies have made it a center of training in criticality safety for the DOE and other institutions. TA-18 presently continues its long history in nuclear criticality research, nuclear weapon's safeguards and security, and treaty verification technology.

2.4.2 Waste Management Practices

Separate individual industrial waste water and sanitary septic systems were constructed for Building TA-18-1 (Figure 2-5); Kiva 2 (Figure 2-4); Kiva 1 (Figure 2-3); Buildings TA-18-30 (Figure 2-7); Buildings TA-18-31 and -37 (Figure 2-5); and Kiva 3 (Figure 2-8). These facilities used septic tanks and drain fields with, in some cases, outfalls near the ephemeral stream channel. As additional buildings were constructed in the central area during the 1960s, they were connected to existing drain fields. Many of the septic systems were deactivated and replaced in 1969 by a centralized sanitary sewage system (Figures 2-9 and -10) that discharged to the sewage lagoons at former TA-27 (Figure 1-4). The kivas, however, presently remain on septic systems. The inactive septic systems remain in place and may contain both radioactive and hazardous constituents. Most of the PRSs in OU 1093 relate to these systems (LANL 1990, 0145; DOE 1987, 0264).

In 1992, TA-18's sanitary sewer system was disconnected from the sewage lagoons and connected to a new sanitary sewage treatment plant at TA-46.

With the addition of more buildings to the central area, storm sewers were constructed to remove runoff. These drained both paved areas and roofs and

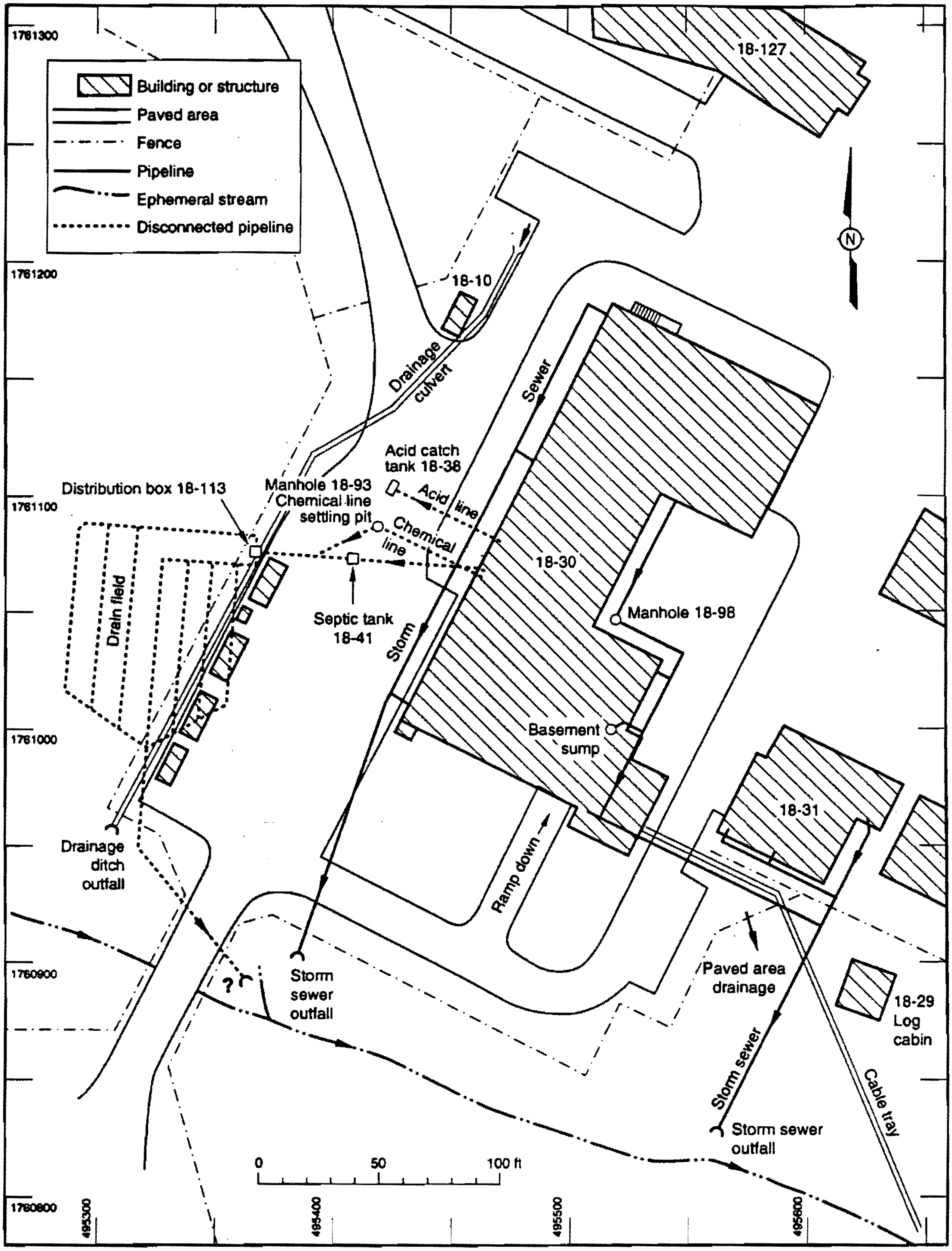


Figure 2-7. Structures and drain systems near Building 30, TA-18.

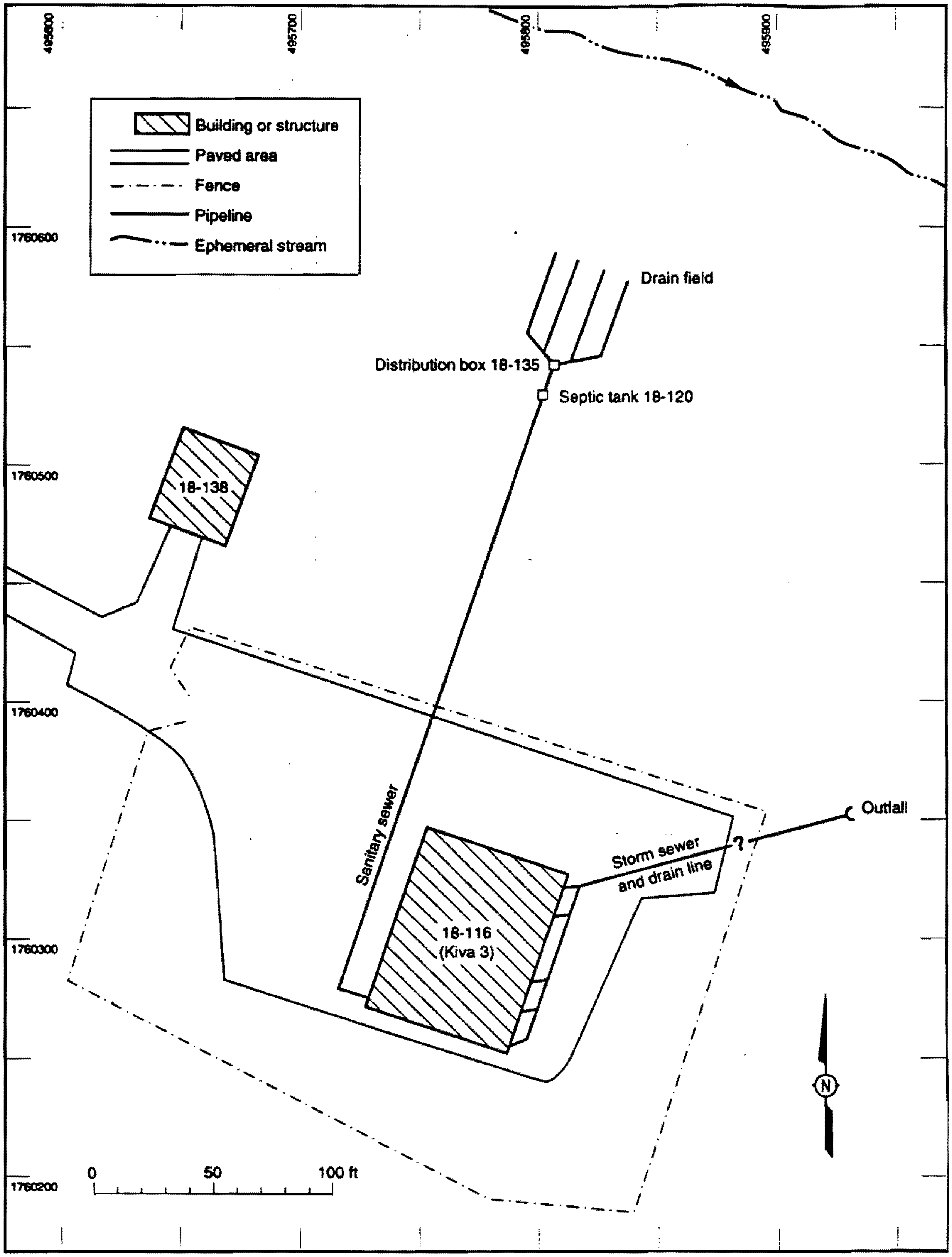


Figure 2-8. Structures and drain systems near Kiva 3, TA-18.

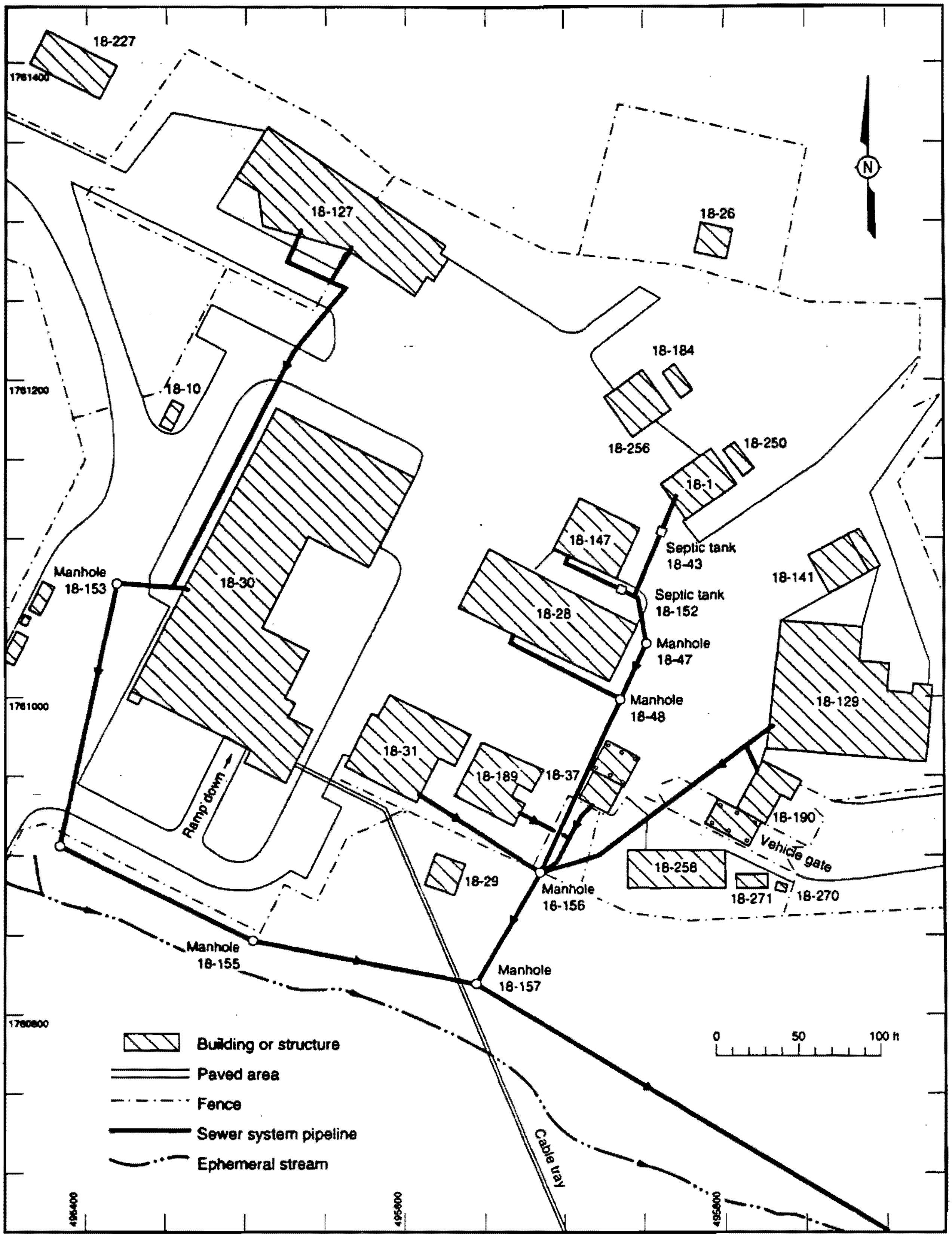
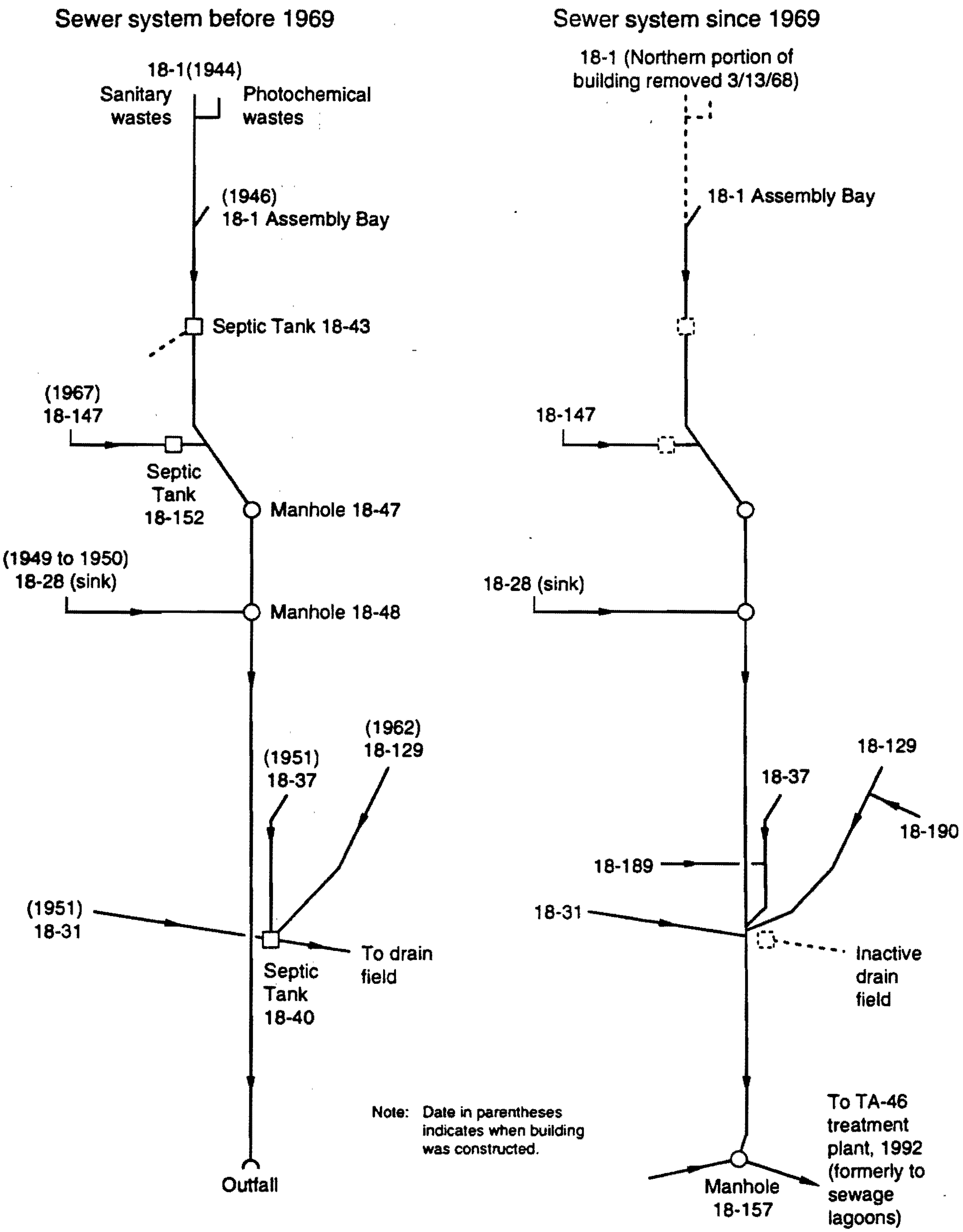


Figure 2-9. TA-18 present sewer system.



Note: Date in parentheses indicates when building was constructed.

Figure 2-10. Schematic representation of sewer system revisions, east-central TA-18.

discharged through outfalls to the ephemeral stream channel in Pajarito Canyon (Figures 2-5 and -7).

Some interior building sinks and floor drains also discharged to outfalls or to drain fields associated with septic systems, such as those at Kivas 1, 2, and 3 and Buildings TA-18-30, -31, and -141 (Figures 2-3, -4, -8, -7, and -5, respectively).

Relatively small volumes of potentially contaminated solid waste have been generated onsite; no routine burials of solid waste are known to have occurred. Wastes have been routinely transported to Laboratory centralized disposal areas. Throughout TA-18's history, a variety of both radioactive and nonradioactive materials have been handled, but there are few documented instances of releases to the environment. Uranium-233, -235, and -238 and nickel-coated plutonium were used in the critical assembly work. One employee commented that during the Rover Program an exceptional quantity of beryllium and cadmium were used at TA-18 (Mynard 1992, 16-0007).

2.5 TA-65

2.5.1 Site History

Once part of TA-18, this small, triangular area on the mesa above and north of TA-18 retains the TA-18 structure numbering system. Numbered structures are a lumber storage building (TA-18-13), removed in 1950; a carpentry shop (TA-18-14), transferred to The Zia Company in 1964 and subsequently removed; and an underground water tank (TA-18-33), which is still in use. According to a former Laboratory employee, the carpentry shop was used as a radiation counting laboratory. There are no PRSs at this site.

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3.0 ENVIRONMENTAL SETTING

The environmental setting of the Laboratory is described in Section 2.5 of the IWP (LANL 1992, 0768). A discussion of the environmental setting of TA-18 and adjacent areas is presented in the following sections and provides the detailed information required to evaluate potential migration pathways and conceptual exposure models at OU 1093.

3.1 Physical Description

OU 1093 is within the midreach of Pajarito Canyon near the intersection of Pajarito and Threemile canyons. Elevations at the site decline eastward from 6,900 to 6,780 ft. The site is bordered to the north by Mesita del Buey and to the south by Pajarito and Threemile mesas. Canyon walls in the area are nearly vertical. The canyon floor consists of volcanic-derived alluvium and is underlain by welded and nonwelded Bandelier Tuff and associated volcanics. Perched groundwater occurs in the alluvium of Pajarito Canyon. The potentiometric surface of the regional groundwater system beneath the Pajarito Plateau lies between 5,900 and 5,870 ft. It is believed that the regional groundwater system is not hydraulically connected with the perched groundwater in Pajarito Canyon (Devaurs 1985, 0046; Purtymun and Kennedy 1971, 0200).

OU 1093 lies entirely on DOE-owned land. In the foreseeable future, land in the area of OU 1093 is anticipated to be used exclusively for Laboratory operations. The residential community of White Rock, New Mexico, lies a few miles east of TA-18 and borders the eastern end of the operable unit, but all other surrounding lands are DOE property. Pajarito Road (a public access road) traverses the length of the operable unit.

3.2 Climate

Los Alamos County has a semiarid, temperate mountain climate. The local climate is discussed in detail in a Laboratory report, "Los Alamos Climatology" (Bowen 1990, 0033), and is summarized in Section 2.5.3 of the IWP.

Los Alamos receives an average of 18 in. of precipitation annually. Of this total, 40% occurs as brief, intense thunderstorms during July and August. Streamflow in Pajarito Canyon occurs as a result of these storms. Snowfall within the townsite averages 51 in. annually, with the surrounding mountains receiving approximately three times this amount. Spring snowmelt runoff also commonly induces streamflow in Pajarito Canyon.

Because of the complex terrain, surface winds in Los Alamos vary greatly with the time of day and location. Within OU 1093, winds are predominantly either southwesterly or northeasterly.

3.3 Biological Resources

During 1992, field surveys were conducted by the Biological Resource Evaluation Team (BRET) of the Environmental Protection Group (EM-8) for TAs-18, -27, and -65 within OU 1093. The surveys were conducted to provide information on the biological components before site characterization. Site characterization requires surface and subsurface soil sampling within the technical areas and associated drainages and canyons. A report regarding the biological field surveys is being prepared for OU 1093. The report will contain specific information on survey methodology, results, mitigation measures, and information that may aid in defining ecological pathways and site restoration.

3.3.1 Summary

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

3.3.2 Methodology

The surveys were conducted to determine the presence or absence of critical habitat for any state or federal threatened, endangered, or sensitive plant or animal species potentially occurring within OU 1093; to determine the presence of sensitive areas, such as flood plains and wetlands, within the areas to be sampled, the extent of such areas, and their general characteristics; and to provide additional plant and wildlife data concerning the habitat types within OU 1093. These data provide further baseline information about the biological components of the site characterization and a determination of presampling conditions. This information is also necessary to support the National Environmental Policy Act documentation and determination of a categorical exclusion for the sampling plan for site characterization.

Surface and subsurface sediment sampling is proposed for OU 1093. Subsurface characterization will involve drilling holes up to or exceeding 200 ft in depth. In some locations, trenching maybe necessary.

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

The habitat information gathered through the field surveys was compared to the habitat requirements for the species of concern as identified in the database search. If habitat requirements were not met, no further surveys were conducted and the site was considered cleared for impact on state and federally listed species. If habitat requirements were met, specific 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 flood plains within the survey area were noted using National Wetland Inventory maps and field checks. Characteristics of wetlands, flood plains, and riparian areas are noted using criteria outlined in the Corps of Engineers Wetlands Delineation Manual (Army Corps of Engineers 1987, 0872).

3.3.3 Results

The species of concern for OU 1093 are as follows:

- northern goshawk (*Accipiter gentilis*-federal candidate);
- Mexican spotted owl (*Strix occidentalis lucida*-federally proposed);
- peregrine falcon (*Falco peregrinus*-federally endangered and New Mexico state endangered);
- common black hawk (*Buteogallus anthracinus*-New Mexico state endangered);
- bald eagle (*Haliaeetus leuccephalus*-federally endangered and New Mexico state endangered);
- Mississippi kite (*Ictinia mississippiensis*-New Mexico state endangered);
- broad-billed hummingbird (*Cynanthus latirostris*-New Mexico state endangered);
- willow flycatcher (*Empidonax trailii*-New Mexico state endangered and federal candidate);
- spotted bat (*Euderma maculatum*-New Mexico state endangered and federal candidate);
- meadow jumping mouse (*Zapus hudsonius*-New Mexico state endangered and federal candidate);
- Say's pond snail (*Lymnaea captera*-New Mexico state endangered);
- Wright's fishhook cactus (*Mammillaria wrightii*-New Mexico state endangered);

- Santa Fe cholla (*Opunita viridiflora*-New Mexico state endangered);
- grama grass cactus (*Toumeya papyracantha*-New Mexico state endangered);
- wood lilly (*Lilium philadelphicum*-New Mexico state endangered); and
- checker lilly (*Fritillaria atropurpurea*-New Mexico state sensitive).

3.3.4 Wetland Areas

Several areas within OU 1093 are potential wetland areas, as illustrated in Figures 3-1 and 3-2. Specific boundaries of wetlands are subject to confirmation by biologists from EM-8 who look for characteristics established by the US Army Corps of Engineers that define wetlands, such as hydrology, hydric soil, and hydrophytic vegetation. Sampling is planned for possible contaminants that may have entered these areas.

3.4 Cultural Resources

As required by the National Historic Preservation Act of 1966 (as amended), a cultural resource survey was conducted during the summer and fall of 1992 at OU 1093. The methods and techniques used for this survey conform to guidelines specified by the Secretary of the Interior (National Park Service 1983, 0632).

Twelve archaeological sites are located in the surveyed area. Ten of these are eligible for inclusion in the National Register of Historic Places under Criterion D because they have the potential to yield research data. Although not eligible for the National Register, the Pajarito Ranch/Pond Cabin is listed in the New Mexico State Register of Historic Properties.

The attributes of these sites that make them eligible for inclusion in the National Register will not be affected by any ER Program sampling activities proposed for OU 1093. A report documenting the survey area, methods, results, and monitoring recommendations, if any, will be transmitted to the New Mexico State Historic Preservation Officer for concurrence in a "Determination of No Effect" for this project (Manz and McGehee, in preparation, 16-0043). As specified in 36 CFR 800.5(b) and following the intent of the American Indian Religious Freedom Act, a copy of this report will also be sent to the governor of San Ildefonso Pueblo and to any other interested tribal group for comment on any possible impact to sacred and traditional places.

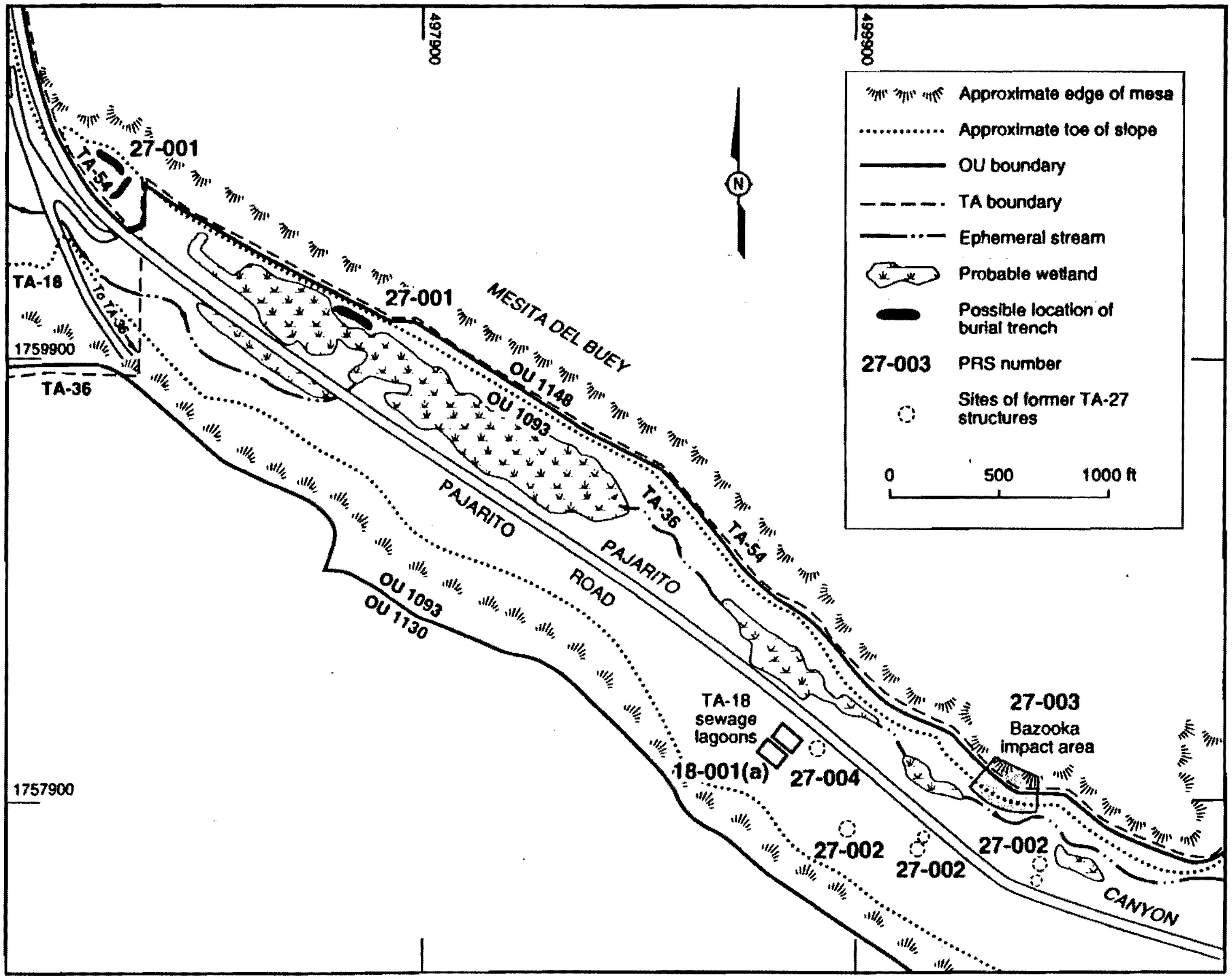

Figure 3-1. Potential wetlands in central portion of OU 1093.

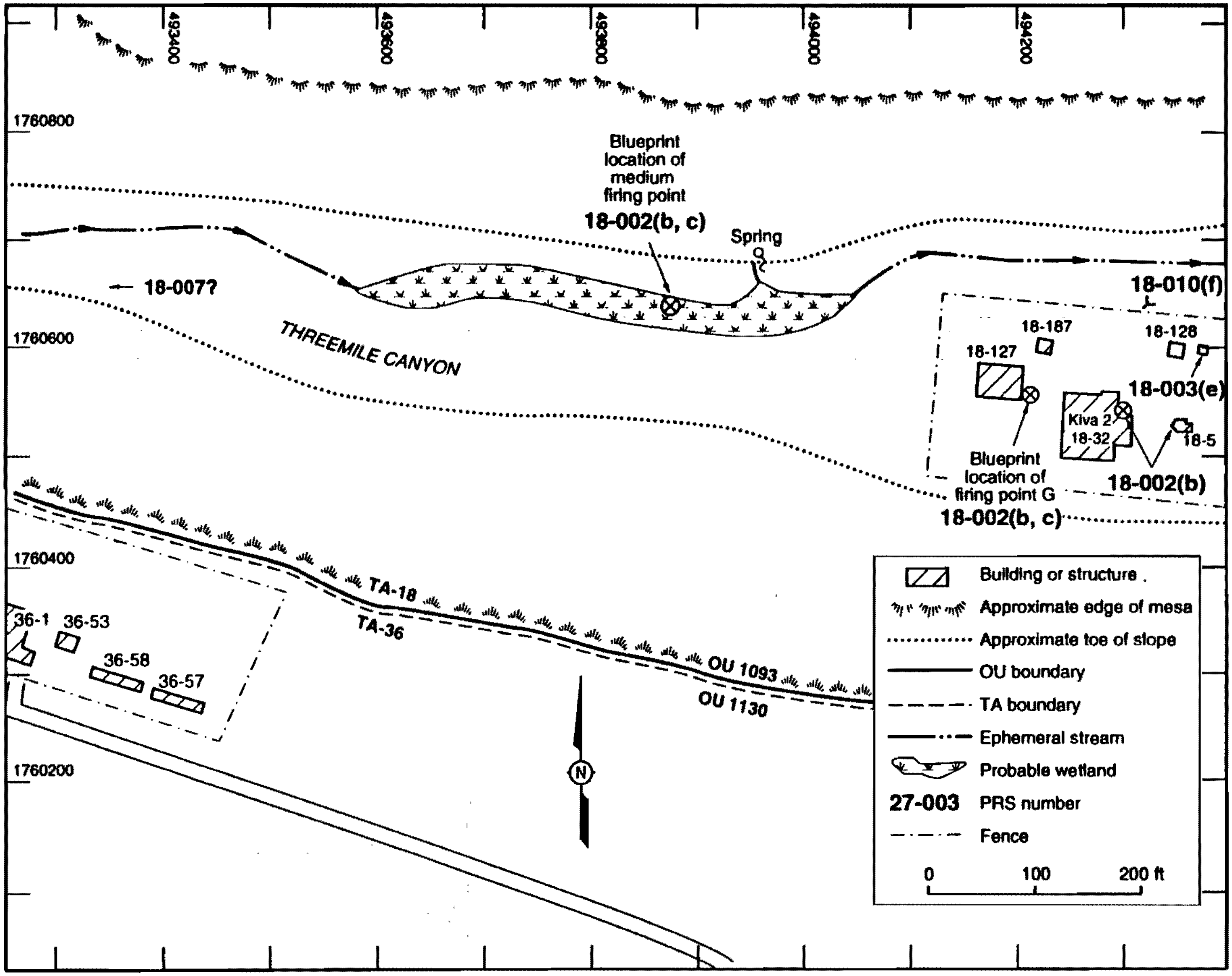

Figure 3-2. Potential wetland in Threemile Canyon at west end of TA-18.

3.5 Geology

A description of the Los Alamos area geology is presented in Section 2.6.1 of the IWP. A summary of that material, emphasizing conditions specific to OU 1093, follows. Specific detail of the geology of Pajarito Canyon in the vicinity of TA-18 has been determined from several studies of Mesita del Buey, directly north of Pajarito Canyon, as well as from a supply well and test holes in Pajarito Canyon east of TA-18 (Purtymun and Kennedy 1971, 0200; Devaurs 1985, 0046; LATA 1991, 16-0005).

3.5.1 Structure

The Rio Grande Rift system, extending from central Colorado to southern New Mexico, is a major tectonic feature of the western United States. Rift-induced crustal extension, as indicated by normal faulting, is the dominant structural control in the area. The Espanola basin is one of several Late Tertiary basins associated with the rift; it forms a 25- to 30-mile-wide depression immediately surrounding Los Alamos. The basin is separated from the Albuquerque-Belen basin to the south by the La Bajada fault zone, and from the San Luis basin to the north by the Embudo fault zone. The basin is bounded to the east by the Sangre de Cristo range and to the west by the Sierra Nacimientos. A prominent fault zone occurs along the western margin of the basin; however, distinct faulting has not been identified along the basin's eastern margin.

The Jemez volcanic field, including the Valles and Toledo calderas, transects the western portion of the Espanola basin. The location and development of the volcanic field has been strongly influenced by the basin's western margin fault system.

The Pajarito Plateau, forming the western rim of the Espanola basin, is composed of basin-fill sediments and volcanic rocks of the Santa Fe group overlain by the Bandelier Tuff erupted during the collapse of the Valles and Toledo calderas. The plateau is transected by six major fault zones of the Pajarito fault system, which define the active western margin of the Espanola basin. Micrograbens, faults, and joints associated with extensional tectonics are common throughout the plateau.

Evidence of faulting can be seen in OU 1093. Faults lacking surface expression have been delineated approximately 0.5 mile east and 1 mile west of TA-18, and other minor faults exist near the area (Vaniman and Wohletz 1990, 0541). Numerous joints that formed because of contraction of the tuff during cooling are common throughout the mesas surrounding OU 1093 and in borehole samples taken from within Pajarito Canyon. Major joints generally dip at angles from 70° to near vertical. Minor joints tend to dip at angles less than 70°. Joint blocks range in size from a few square feet to more than 500 ft^2 in surface exposures. The average interval between major joints is approximately 7 ft. Joint openings range from less than 0.25 in. to more than 2 in., but are typically filled with clay and weathering products and precipitation minerals leached from the surrounding tuff (Purtymun and Kennedy 1971, 0200).

3.5.2 Bedrock Stratigraphy

Pleistocene ash flows and ash falls of Bandelier Tuff directly underlie the alluvial channel-fill deposits forming the floor of Pajarito and Threemile canyons. The subsurface thickness of the Bandelier Tuff is approximately 375 ft near TA-18,; thins to approximately 150 ft, 2 miles to the east; and pinches out entirely in the canyon bottom near State Road 4. The Bandelier Tuff has been divided into two distinct members, each of which is comprised of a lower air-fall pumice bed and an upper sequence of ignimbrite flow sheets. The lower Otowi member, including the basal Guaje pumice bed, and the upper Tshirege member are intersected by boreholes previously drilled within this operable unit. The Tsankawi pumice bed, which forms the basal air-fall pumice bed of the Tshirege member at certain locations on the Pajarito Plateau, does not outcrop at and is not expected in the subsurface at OU 1093 (Crowe et al. 1978, 0041).

The Guaje pumice bed is an ash-fall pumice that directly overlies the Cerros del Rio basalts and the Puye Formation. The Guaje is characterized by loosely compacted, large (>2 in.) gray pumice fragments. The pumice bed varies from approximately 30 ft in thickness in the western portion of Pajarito Canyon to approximately 10 ft toward the eastern end. The Otowi member is predominantly an ash-flow deposit of light gray, nonwelded rhyolitic tuff. Rock fragments of pumice, rhyolite, and dacite are common throughout the deposit. Several thin beds of reworked pumice and tuff overlie the top of the unit.

The Tshirege member comprises all of the surface rocks exposed at OU 1093. In mapping the Tshirege member in outcrops at Mortandad Canyon, the flow sheets were subdivided into three units based on the degree of welding (Baltz et al. 1963, 0024). The units, as established by Baltz, were used by Purtymun and Kennedy (Purtymun and Kennedy 1971, 0200) to map Mesita del Buey just north of OU 1093. A summary of their description of the Tshirege at Mesita del Buey follows. The lower layer of the Tshirege is a light orange to light brown pumiceous tuff capped by a grayish brown tuff. The tuff is variously nonwelded to moderately welded. The subsurface thickness of the unit is approximately 55 ft in the western end of the mesa, thinning to less than 35 ft to the east. Unit 2 is predominately a moderately welded ash-flow tuff that grades eastward into a nonwelded ash-fall pumice and tuff. The upper portion of Unit 2 is a moderately welded to welded ash-flow rhyolite tuff. The entire thickness of Unit 2 ranges from 145 ft in the west to 90 ft in the eastern reaches of Mesita del Buey. The uppermost unit of the Tshirege member is not present in the subsurface nor in outcrops surrounding OU 1093.

3.5.3 Surficial Deposits

3.5.3.1 Alluvium and Colluvium

Alluvium in Pajarito Canyon is approximately 20 to 30 ft thick. In the upper reaches of the canyon, the alluvium is composed of sands and boulders, pebbles, and cobbles of dacite and rhyolite derived from the Tschicoma Formation volcanic flow rocks of the Sierra de los Valles. In the area of OU 1093, the alluvium consists of sands, clayey sands, sandy clays, and clays, as well as pebbles and cobbles of Bandelier Tuff derived from the surrounding mesas. Significant deposits of Bandelier-derived volcanic gravels have also accumulated in the canyon east of TA-18. These tuff gravels and cobbles are typically subrounded to rounded, indicating streambed deposition. The sediment layers are poorly to well sorted. The sand and clay lenses are laterally discontinuous, highly variable, and range from a few inches to over a foot in thickness.

3.5.3.2 Soils

The development and types of soils on the Pajarito Plateau are discussed in detail in Section 2.6.1.3 of the IWP. Canyon bottom soils are typically well-drained soils of the Totavi series, as classified by Nyhan (Nyhan et al. 1978, 0161). In general, the prevalent soil types have not been geochemically and hydrogeologically characterized to the extent necessary for effective contaminant-transport analysis.

3.5.3.3 Erosional Processes

Active erosional processes on the Pajarito Plateau are addressed in Section 2.6.1.6 of the IWP. At OU 1093, the primary erosional process is the movement of sediments through the canyon bottom during periods of streamflow. Rates of erosion, sediment transport, and sediment deposition in the canyon bottoms are not well known. Minor amounts of wind erosion may also be occurring in the area.

3.6 Conceptual Hydrologic Model

3.6.1 Surface Water

Pajarito Canyon heads on the flanks of the Sierra de los Valles west of the Pajarito Plateau. The drainage basin area from the headwater of the canyon to the Laboratory's eastern boundary is approximately 10.6 mi^2. Streamflow in short sections of the canyon is perennial on the flanks of the mountains and the western portion of the plateau and ephemeral across the eastern plateau, where the canyon passes through TA-18 to the Rio Grande. A significant volume of surface flow recharges the unconfined perched groundwater body in the channel-fill alluvium of the canyon, and the remainder is lost through evapotranspiration (Purtymun and Kennedy 1971, 0200; LATA 1991, 16-0005). Gravel pits east of TA-18 have been excavated into the top of the perched water table and frequently contain ponded water. Semipermanent wetlands have developed in the abandoned pits. Storm water runoff drains into the canyon from the flanks of the mountains and the surrounding mesas. During peak flow events, streamflow in Pajarito Canyon may reach the Rio Grande. The streambed has been channelized with earthen berms in some locations within TA-18 to protect facilities from flood damage (LATA 1991, 16-0005); however, site inspections suggest that the existing earthwork will have little effect on the potential for contaminant migration into the stream channel.

The elevation and location of the 100-year flood plain has been determined for all Laboratory drainages (McLin 1992, 0825). In Pajarito and Threemile canyons, the 100-year flood plain occupies an area more or less centered on the stream channel and varying in width from 25 ft up to more than 300 ft (Figure 3-3). PRSs near or adjacent to the stream channel are, therefore, within the 100-year flood plain. Nearly all of the TA-18 structures are above the 100-year flood plain and, therefore, most PRSs associated with existing structures are above the 100-year flood plain. The sewage lagoons in Pajarito Canyon east of TA-18 are above the 100-year flood plain, but the two easternmost firing sites (SWMU 27-002) are within the flood plain.

3.6.2 Hydrogeology

A brief overview of the hydrogeology of the Pajarito Plateau is presented in Section 2.6.2 of the IWP. The following sections provide hydrogeological information specific to OU 1093.

3.6.2.1 Vadose Zone

The vadose zone hydrogeology of the Pajarito Plateau is presented in Section 2.6.3 of the IWP. The summary provides the fundamental hydrogeologic properties of the Bandelier Tuff and discusses the movement of fluids through the tuff. The properties of the tuff underlying OU 1093 are expected to be similar to the properties summarized in the IWP. In undisturbed areas, clay soils are often present that significantly inhibit the downward movement of liquids into the tuff (Purtymun and Kennedy 1971, 0200). Further, investigations conducted to date indicate that dry Bandelier Tuff substantially impedes the movement of fluids in the subsurface (LANL 1992, 0768).

Previous investigations at TA-18 show that approximately the upper 15 ft of alluvium and soil is under unsaturated conditions (LATA 1991, 16-0005). The vadose zone hydrogeology of these sediments has not been thoroughly characterized.

3.6.2.2 Saturated Alluvium

The channel-fill alluvium at OU 1093 contains a perennial shallow body of groundwater, as evidenced by shallow monitoring wells and wetland development. Directly beneath the main facilities at TA-18, the alluvium is saturated below a depth of about 15 ft to a depth of approximately 30 ft, where the alluvium contacts the Bandelier Tuff. Boreholes indicate that the shallow groundwater body is confined to the alluvium and does not extend underneath the mesas north and south of OU 1093. The alluvial system is recharged by infiltration along the entire length of the canyon. Water is believed to be lost from the shallow groundwater system only through evapotranspiration and discharge to wetland areas, but this has not been rigorously verified. As is typical of shallow perched groundwater bodies of the Pajarito Plateau, the water table is extremely variable and is highest in the spring due to snowmelt and in late summer due to thunderstorms. The water table declines during early summer

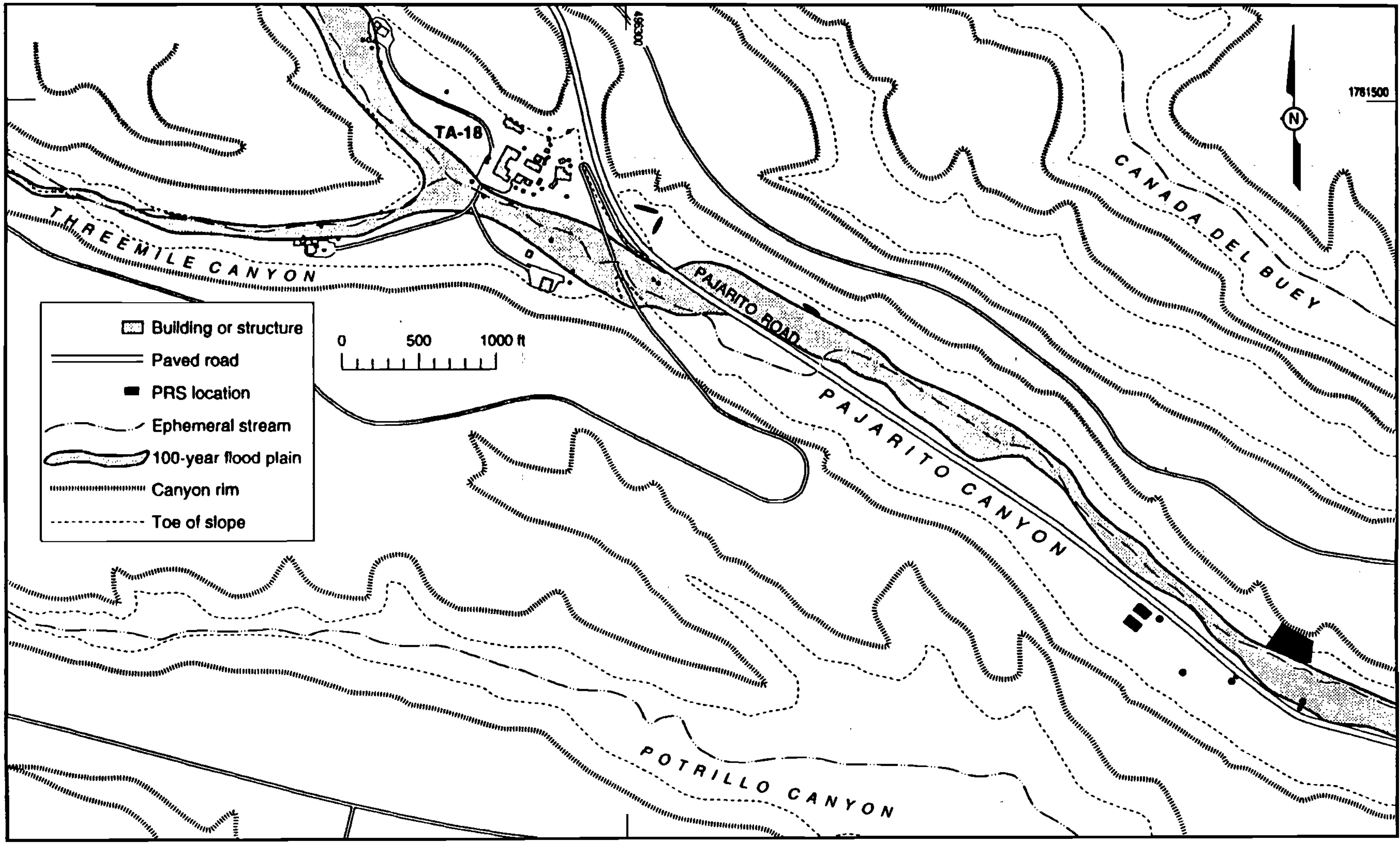

Figure 3-3. Location of 100-year flood plain in Pajarito and Threemile canyons.

and again during fall. The hydraulic gradient in the saturated alluvium is shallow, and spatially and seasonally variable. Measured hydraulic conductivity ranges from 0.012 to 0.035 ft/day (LATA 1991, 16-0005); however, these values are much lower than is typical of Pajarito Plateau alluvium, and higher values are likely in the canyon. The direction of groundwater flow is predominantly toward the Rio Grande. There are currently no water supply wells pumping water from the alluvial groundwater body.

3.6.2.3 Perched Groundwater Bodies

No perched water is known to exist between the shallow alluvial groundwater body and the main aquifer below OU 1093 (Devaurs 1985, 0046).

3.6.2.4 Main Aquifer

A thorough discussion of the main aquifer underlying the Pajarito Plateau is presented in Section 2.6.6 of the IWP. Approximately 300 ft of dry Bandelier Tuff lies between the alluvial groundwater body in Pajarito Canyon and the main aquifer. Although it is believed that there is no hydraulic connection between the alluvial aquifer and the main aquifer, there are no conclusive data to support this contention.

3.7 Conceptual Three-Dimensional Hydrogeologic Model of OU 1093

Figure 3-4 graphically summarizes the general geology and hydrogeologic processes occurring within OU 1093. The dominant contaminant-transport process is surface erosion and sediment/solute transport. Some subsurface transport through the vadose zone or within the alluvial groundwater body could occur. No saturated zone is present between the alluvial groundwater and the main aquifer. The magnitude of unsaturated zone groundwater flow is uncertain, but is expected to be small.

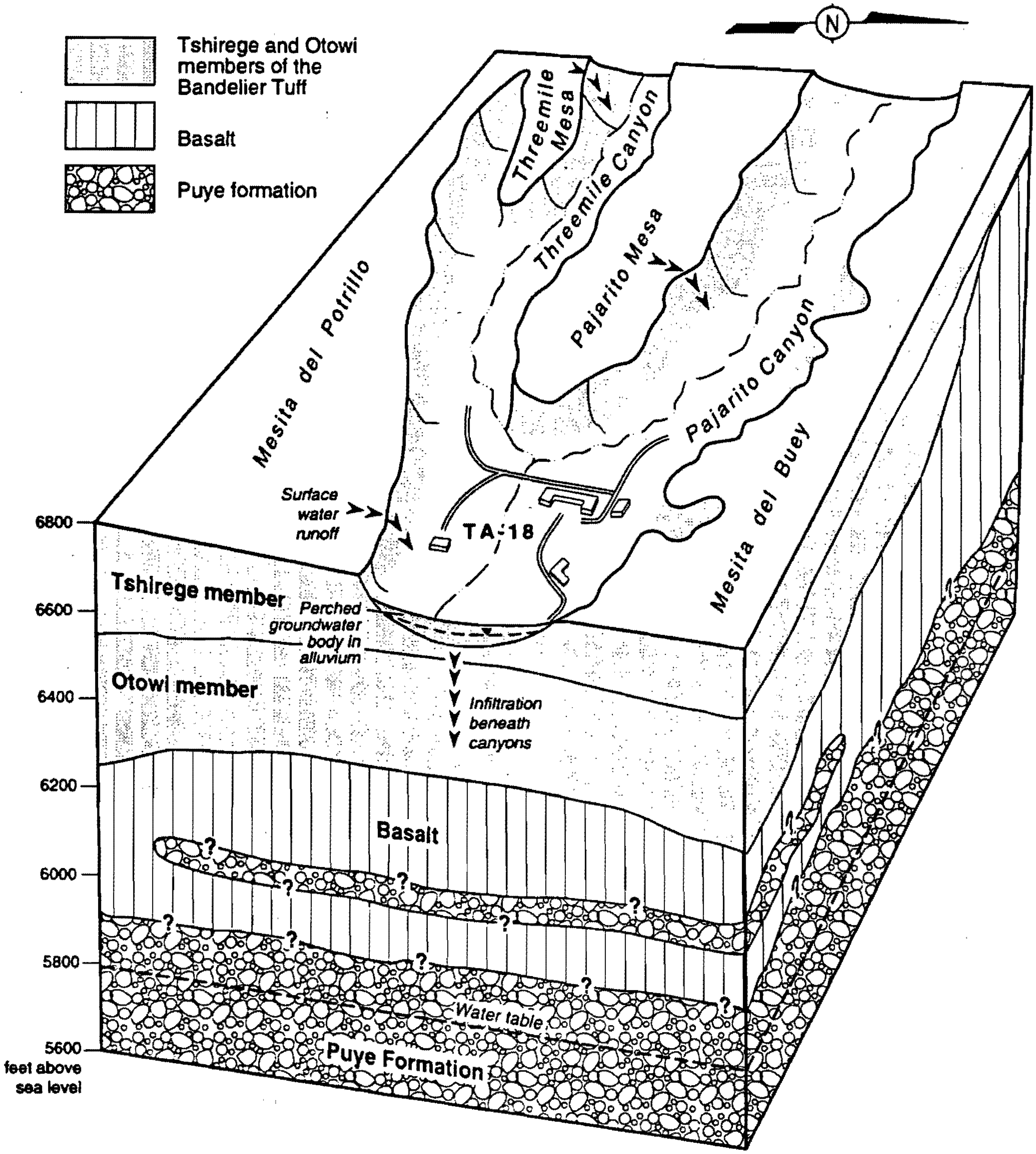

Figure 3-4. Three-dimensional hydrogeologic model of OU 1093.

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Executive Summary

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Introduction

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Background Information for OU 1093

Chapter 3
Environmental Setting

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Technical Approach

Chapter 5
Evaluation of Potential Release Sites

Chapter 6
Potential Release Sites Proposed for No Further Action or Deferred Investigation

Annexes

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Chapter 4

- Aggregation of PRSs
- Site Characterization
- Conceptual Models
- Response Actions
- Sampling Strategies and Methods
- Analytical Methods
  Mitigation of Impacts on Biological and Cultural
- Resources

4.0 TECHNICAL APPROACH

4.1 Aggregation of PRSs

The PRSs in OU 1093 for which site characterization is planned have been aggregated into five groups: liquid waste management systems; an underground storage tank; surface contamination from abandoned firing sites and structures; storm sewer outfalls; and buried materials, including a disposal area, a bazooka impact area, and, possibly, a military tank. This aggregation was based on the similarity of constituents potentially released to the PRSs, transport processes affecting the PRSs, and sampling strategies that would be applied to the PRSs. The PRSs in a particular aggregate are generally not in the same immediate area; however, because of the relatively small size of TAs-18 and -27 combined, all PRSs in this operable unit share many common site characteristics, such as being located in the canyon bottom, in alluvium, overlying a shallow groundwater body.

4.2 Approaches to Site Characterization

This work plan adheres to the ER Program technical approach for data collection and evaluation as documented in Chapter 4 of the IWP (LANL 1992, 0768). This technical approach adopts the philosophy of the Observational Approach (Appendix G of the IWP), which bases decisions for action (e.g., collecting additional data versus moving from the facility investigation to the corrective measures study [CMS]) on definitions for acceptable uncertainties that depend on the current phase of the investigation. Investigations are phased so that decisions remain closely tied to the ultimate goal of selecting an appropriate corrective action and so that they are formulated in light of what is already known about the site. The phased approach allows intermediate data evaluation in order to develop better focused sampling plans targeted to collect the data needed to make a decision. The ER Program has adopted a risk-based approach to making corrective action decisions during the RCRA facility investigation/corrective measures study (RFI/CMS) process. In this work plan, the data quality objectives process (Chapter 4 and Appendix H of the IWP) is used to identify site-specific risk-based decisions or risk-related questions, to identify and, in some cases, quantify risk-based decision errors, and to specify sampling designs to support the risk-based decisions or risk-related questions.

4.2.1 Decision Model

A goal of this RFI is to detect the presence of contaminants of concern. Contaminants of concern are defined as any hazardous or radioactive constituents whose levels (adjusted for background) are above screening action levels (LANL 1992, 0768). Screening action levels are media-specific concentration levels for potential contaminants derived using conservative criteria. They are discussed in Section 4.2.2.

The decision logic for development of this work plan and subsequent RFI/CMS activities is illustrated in Figure 4-1. As shown in the figure, the first step

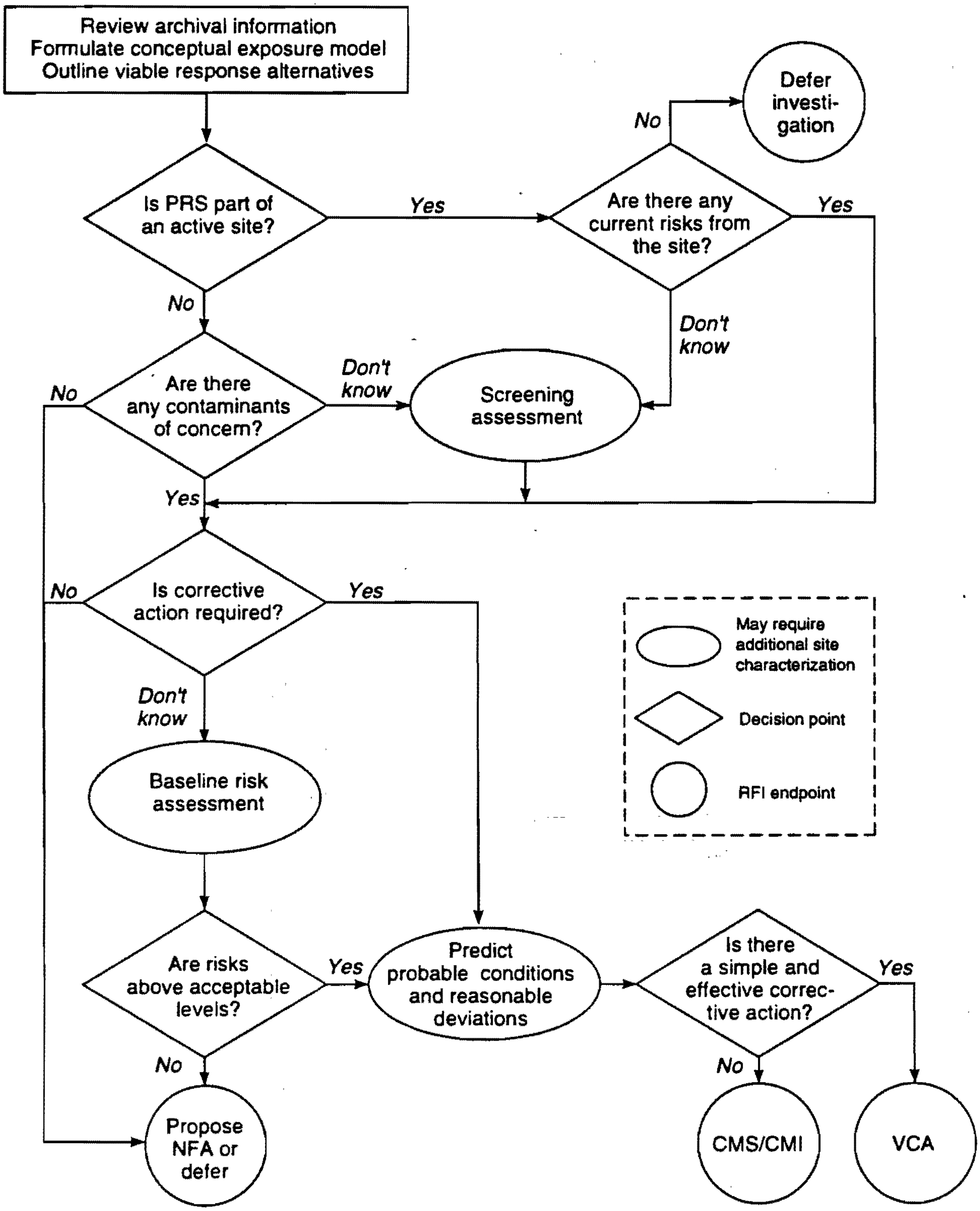


Figure 4-1. Decision logic for site investigations.

is to evaluate the archival information and make field reconnaissance visits to formulate a site conceptual model. These data help develop a list of potential contaminants of concern.

As shown in Figure 4-1, no further action (NFA) or deferred investigations may be recommended after the first step of the RFI. Criteria for NFA based on archival information are discussed in Section 4.4.1, and the details are described in Appendix I and Section 4.1 of the IWP (LANL 1992, 0768). The PRSs recommended for NFA or deferred investigation, based on archival information, are presented in Chapter 6.

In some cases, existing site data are adequate to identify the need for a corrective action. If there is an obvious, feasible, and effective remedy, a voluntary corrective action (VCA) (Section 4.2.3) will be implemented; otherwise a CMS will be required.

For most PRSs in OU 1093, the archival information indicates that it is highly probable there are no contaminants of concern at the site, but there are few existing data and the archival information is not sufficient to recommend NFA. For these sites, and sites where virtually no information exists, a screening assessment will be conducted to determine the presence or absence of contaminants of concern. A primary goal of screening assessments is to identify PRSs that pose no hazard to human health or the environment so that they can be recommended for NFA. Eliminating nonproblems through screening assessments allocates resources efficiently and effectively, and provides timely corrective actions for PRSs that present the greatest potential hazard.

Descriptions of sampling strategies for screening assessments are given in Section 4.5. Two kinds of sampling strategies used in a screening assessment: reconnaissance sampling and preliminary baseline risk assessment sampling. Reconnaissance sampling is used to determine if there are any contaminants of concern at a PRS when there is little or no historical information. Preliminary baseline risk assessment sampling is used to collect data to support two decisions: determining if there are any contaminants of concern by comparing concentrations to screening action levels, and performing a baseline risk assessment (collect data that is representative of the upper 95th percentile limit of the average concentrations of potential contaminants of concern).

If contaminants of concern are detected in the screening assessment, a baseline risk assessment will be performed, and a decision will be made to implement a VCA or to perform a CMS. Additional characterization data may be required for these phases. The additional data may be needed to evaluate the extent of any bias introduced by judgmental sampling in Phase I or to provide a more extensive database for risk assessment. In other instances, field screening or analytical data developed during a Phase I investigation may support evaluation of the bias in the reconnaissance data.

4.2.2 Screening Action Levels

Screening action levels are media-specific concentration levels for potential contaminants of concern derived using health-conservative criteria. In most cases, screening action levels for nonradiological potential contaminants are based on the methodology in proposed Subpart S to RCRA to calculate action levels (EPA 1990, 0432). Radiological screening action levels are based on a 10-mrem-per-year incremental dose using a residential use-exposure scenario; however, if a regulatory standard exists and is lower than the value derived by these methods, this lower value is used as the screening action level. The derivation of screening action levels is discussed in Chapter 4 and in Appendix J of the IWP (LANL 1992, 0768).

Screening action levels are tools for efficiently discriminating between problem and nonproblem sites so that resources are used effectively. Screening action levels are not cleanup levels; cleanup levels are based on site-specific risk evaluations and as low as reasonably achievable (ALARA) criteria; however, in some instances, screening action levels may be used as surrogate cleanup levels. In most cases, cleanup levels may be higher than screening action levels. For example, if the site will never be used for residential use, the site-specific land-use scenario (e.g., recreational use) could allow higher levels of soil contamination than the conservative residential-use scenario used to calculate screening action levels.

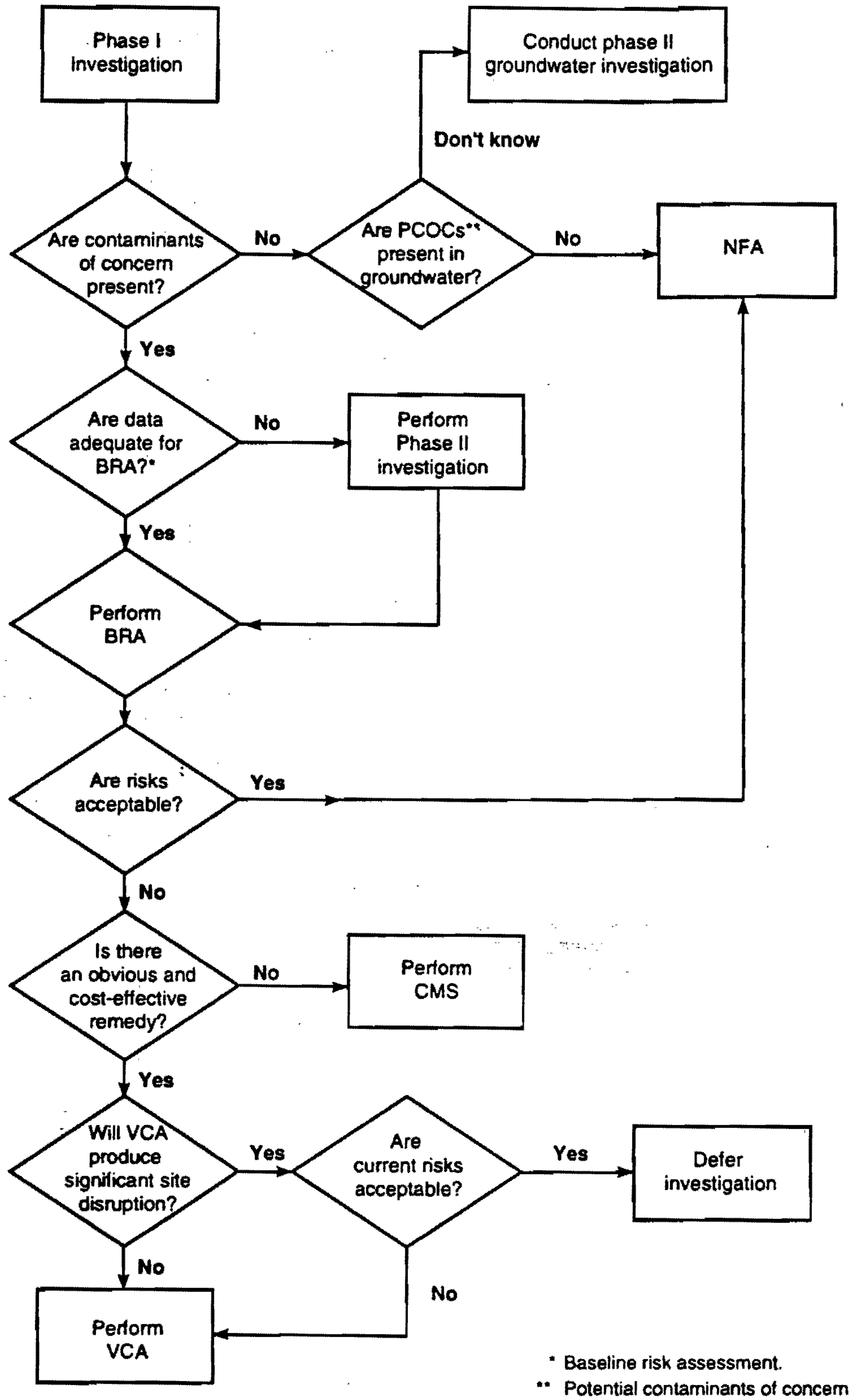
4.2.3 Voluntary Corrective Actions

VCAs may be proposed at any stage of the RFI as an expedited alternative to the complete RCRA program with a formal CMS phase. A VCA may be proposed for a PRS if contaminants of concern have been identified and an obvious and effective remedy, which meets treatment and disposal restrictions and other limiting criteria, is available. Implementing a VCA requires a DOE-approved change control. VCAs on sites that contain mixed or land-disposal-restricted wastes may not proceed without a plan for storage and/or disposal of these wastes that has been approved by DOE and the appropriate regulatory agencies. VCAs will be described in technical quarterly reports to EPA, and the public will be informed of VCAs in quarterly public meetings, but the ER Program will not formally solicit EPA approval until it requests final approval of the cleanup.

4.2.3.1 Inactive PRSs

The decision logic for actions subsequent to Phase I investigations is presented in Figure 4-2, and specific sampling strategies associated with this logic are described in Section 4.5. The goal of the Phase I investigation in OU 1093 is to detect the presence of contaminants of concern in the PRSs, surface soils, and alluvial groundwater. Alluvial groundwater and surface soils will be sampled in conjunction with most PRSs to ascertain the current environmental and health risks, respectively, caused by migration from the source term.

Soil sampling will occur for all PRSs during Phase I, but sampling of alluvial groundwater is not planned for Phase I investigations for all PRSs. For PRSs without groundwater sampling, if concentrations of potential contaminants of concern in the soils exceed background concentrations, it will be assumed that potential contaminants of concern could be present in groundwater, and a Phase II groundwater investigation will be conducted. If Phase I investigations



* Baseline risk assessment.

** Potential contaminants of concern.

Figure 4-2. Decisions logic for actions subsequent to Phase I investigations.

indicate concentrations of potential contaminants of concern below screening action levels in both soil and groundwater, the PRS will be proposed for NFA. If either Phase I or Phase II investigations detect contaminants of concern in either soil or groundwater, a baseline risk assessment will be performed to assess current and future risks.

The baseline risk assessment will also serve as a site-specific determination of cleanup levels. If more data are required for the baseline risk assessment, a Phase II investigation will be conducted. After the risk has been calculated, a decision will be made to propose NFA, implement a VCA, perform a CMS, or defer action. Deferred action would be considered in cases where the VCA would produce major site disruption requiring extensive reconstruction of site facilities.

4.2.4 Active PRSs

Many PRSs in OU 1093 are part of active systems. These include septic tanks and associated drain fields (SWMUs-18-003[a-h]), storm sewer outfalls (AOCs 18-010[a-f]), and sumps with associated drain lines and outfalls (PRSs 18-012[a-d]). Because of changes in operations at TA-18, many of the contaminant sources for these PRSs no longer exist; thus, contamination could be present only because of past practices. Active operations could change site conditions; therefore, it is not appropriate to characterize these areas or to evaluate corrective actions at this time. Final investigations and permanent corrective actions (if required) for active PRSs will be addressed at the time they become inactive.

These proposals for deferred investigation, however, must be accompanied by a determination that the PRSs pose no unacceptable current risk to human health or the environment. Therefore, the RFI will ascertain if migration of contaminants from active PRSs in OU 1093 present a health, safety, or environmental hazard. If a hazard exists from migration of potential contaminants, either a Phase II survey will be conducted or a VCA will be implemented.

4.3 Conceptual Exposure Models for OU 1093

A conceptual model was developed to identify potential contaminant migration pathways and any potential human receptors. This information helps to specify the location and magnitude of sampling and the analytical methods needed to accurately characterize PRSs at OU 1093. A conceptual model includes four elements: identification of potential contaminants; characterization of the release of contamination; determination of migratory pathways; and identification of human receptors.

4.3.1 Generic Source Information

There are several potential contaminants of concern at numerous PRSs in this operable unit. This section addresses them and the physical, chemical, or radiological properties that influence their mobility and/or degradation in the environment.

4.3.1.1 Potentially Hazardous Chemicals

4.3.1.1.1 Potential Contaminants from Firing Site Activities

There are several types of potential contaminants that may be present in the soils, sediments, and/or groundwater at firing sites where explosives were tested and detonated. These may include asbestos and inorganic metals (e.g., barium, beryllium, lead, uranium, copper, and iron) from the device that contained the explosive; the residual parent explosive, including production impurities and inorganic metals; products of incomplete detonation; and degradation products.

Types of Explosives

Explosives can be divided into three classes: primary or initiating, boostering, and secondary (bursting charge) or high explosives (WX-3 SOP 1.1.0).

Primary explosives are used in squibs, low-energy detonators, fuses, and explosive bolts and fasteners, and are assembled into test devices. Lead azide and lead styphnate are examples of primary explosives. The majority of detonators assembled into test devices are the exploding bridge wire-type that contain boostering explosives such as HMX (cyclotetramethylene-tetranitramine), RDX (cyclonitrite, cyclotrimethylenetrinitramine), and tetryl. Examples of high explosives include baratol, the cyclotols, TNT (trinitrotoluene), and several plastic-bond explosives (PBX) and extrudable explosives (XTX).

The parent explosive generally consists of the primary explosive organic (e.g., HMX, RDX, PETN [pentaerythritol tetranitrate], TNT, and tetryl) and bonding material such as plasticizers, polystyrenes, waxes, etc. These explosives may also contain production impurities and inorganic constituents such as aluminum, boron, barium, copper, iron, lead, and zinc. Cyanuric acid (a form of cyanide) and cesium may also be present.

Potential Contaminants of Concern

Several of the constituents and/or degradation products of these explosives and their associated experimental devices are carcinogens and/or systemic toxicants. Explosive constituents (i.e., parent explosives and their production impurities and environmental degradation products) that have been detected in the environment (Layton et al. 1987, 16-0035) and have health criteria values developed by the EPA have been selected as contaminants of potential concern. These include the parent explosives of RDX, HMX, tetryl, PETN, and TNT, their manufacturing impurities, and the environmental degradation products of TNT (i.e., 2,4-DNT [2,4-dinitrotoluene], 2,6-DNT [2,6-dinitrotoluene], 1,3-DNB [1,3-dinitrobenzene], and 1,3,5-TNB [1,3-trinitrobenzene]). Other constituents of potential concern at firing sites include barium nitrate and diphenylyamine.

Fate and Transport

Equilibrium distributions among eight compartments (i.e., air, air particles, biota, upper soil, lower soil, groundwater, surface water, and sediments) of an environmental landscape in two ecoregions (western and southeastern) demonstrate that organic explosive constituents will reside primarily in the subsurface soil and groundwater (Layton et al. 1987, 16-0035).

Metal constituents, which may compose a portion of the explosive or may compose the unit that houses the explosive, are expected to be oxidized during detonation. Oxidized metals are not very soluble and may be expected to be in surface soils.

Asbestos materials that may have composed the housing unit for some of the explosives are also insoluble and are expected to be in surface soils.

4.3.1.1.2 Metal Constituents

In addition to those derived from firing sites, metal constituents may be present in all liquid wastestreams discharged at OU 1093. In general, the mobility of metals in the environment is governed primarily by soil pH. Metals tend to be more mobile in an acidic environment; however, other factors may mediate the effects of soil pH on metal mobility. Barium and beryllium are two constituents of potential concern at processing, assembly, and storage locations that exhibit very low mobility in soils and whose mobility is moderated by factors other than soil pH.

Barium exhibits very low mobility in soil. The primary factors influencing barium mobility are the cation-exchange capacity and the calcium carbonate ($CaCO_3$) content of the soil (Clement International Corporation 1990, 0874). Barium mobility is limited by adsorption in soils with high cation-exchange capacity (e.g., finely textured mineral soils [clays] or soils with a high organic matter content (Clement International Corporation 1990, 0874). Thus, in soils that meet the aforementioned criteria, barium may be expected to be near the soil surface.

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

4.3.1.1.3 Volatile Organic Compounds

Solvents comprised of volatile organic compounds (VOCs) may also have been present in liquid waste discharges. Solvents and other cleaning agents are commonly associated with machine shop and parts cleaning operations.

Volatilization from solution, soils, and/or sediments will be a significant transport mechanism. In general, potential contaminants that have a high water solubility are less likely to vaporize than those with a lower water solubility. Potential contaminants with a higher Henry's law constant (more volatile) may be expected to partition into the atmosphere to a greater degree than those with a lower Henry's law constant.

Leaching is a significant transport mechanism for potential contaminants with a high water solubility. The ability of a potential contaminant to bind with organic matter (K_{oc} value) may mitigate its tendency to leach to lower soil horizons. Thus, water-soluble potential contaminants with a high K_{oc} value will tend to remain in soils or sediments.

The conditions of the media also affect the relative tendency of potential contaminants to volatilize or remain in solution, soil, or sediments. For example, volatility occurs more readily in dry soils than in soils with a higher moisture content. Increased soil porosity also increases the relative volatility of a potential contaminant from soils. Volatility from solution is also expedited under increased flow rate, turbulence, and temperature. The depth of incorporation of a potential contaminant also affects the relative rate of volatilization of a potential contaminant. Potential contaminants located at greater depth will take longer to volatilize from the media of concern.

In general, VOCs are soluble in water and have a low K_{oc} value. Thus, they tend to volatilize and to leach to lower soil horizons and to groundwater.

4.3.1.2 Radionuclides

Radioactive decay is the process whereby a radionuclide is converted to some other radioactive or stable element. Radioactive decay results in the release of radioactive particles (alpha, beta, or gamma radiation). The half-life of a radionuclide is the length of time required for one-half of a given quantity of a radionuclide to be converted to the next lowest material in the radioactive decay chain (decay product); the half-life is thus a measure of how rapidly a radionuclide disappears and how rapidly a decay product is created. Some decay products are of more concern than the original radionuclide. The half-life is different for every radionuclide, but is an immutable quantity. The half-lives for radioactive elements that are suspected constituents within OU 1093 are presented in Table 4-1. The quantity of a radionuclide, Q_n, remaining after "n" years can be computed by:

$$Q_n = Q_o \exp[-0.69n/t_{1/2}]$$

where $t_{1/2}$ is the half-life, and

Q_o is the original quantity

Thus, for a radionuclide such as polonium-210, with a half-life of 140 days, the original quantity will be reduced by a factor of 5×10^{-32} of original quantity after 40 years.

Any uranium, thorium, or plutonium used in operations at TAs-18 or -27 was in relatively pure form isotopically. Although radioactive decay will lead to ingrowth

TABLE 4-1

DECAY CHARACTERISTICS OF RADIONUCLIDES IN OU 1093

Radionuclide Products	Half-Life
Polonium-210	140 days
Uranium-233	1.6×10^5 years
Uranium-234	2.5×10^5 years
Uranium-235	7.1×10^8 years
Uranium-238	4.5×10^9 years
Thorium-230	8.0×10^4 years
Plutonium-238	86.4 years
Plutonium-239	2.4×10^4 years

of decay products, the long half-lives of these isotopes results in only very small quantities of decay products being present.

4.3.2 Potential Environmental Pathways

Chemical or radionuclide potential contaminants of concern may have been released to the environment by liquid waste management systems; an underground storage tank; surface contamination from abandoned firing sites and structures; storm sewer outfalls; and buried materials, including a disposal area, a bazooka impact area, and, possibly, a military tank. This section will address potential pathways by which radioactive or hazardous constituents originally present within these PRSs could have migrated to other locations. The pathway descriptions provide the

justification for the sampling strategies presented in Section 4.5.1 and, by extension, the sampling plans presented in Chapter 5. The pathways of concern for OU 1093, illustrated in Figure 4-3, are discussed in the following sections.

4.3.2.1 Surface Transport

All PRSs in OU 1093 are within Pajarito Canyon or a tributary, Threemile Canyon, and all PRSs are in areas that are either vegetated or paved. Rates of surface erosion are low, with little or no gullying occurring. Rainfall and snowmelt tend to infiltrate vegetated unpaved surfaces rather than appearing as overland flow and runoff. Thus, constituents originally deposited on the land surface outside of drainage channels would tend to remain in place or, if they were soluble, be leached downwards by percolating rainwater or snowmelt. Some overland flow does occur, and drainage channels immediately adjacent to

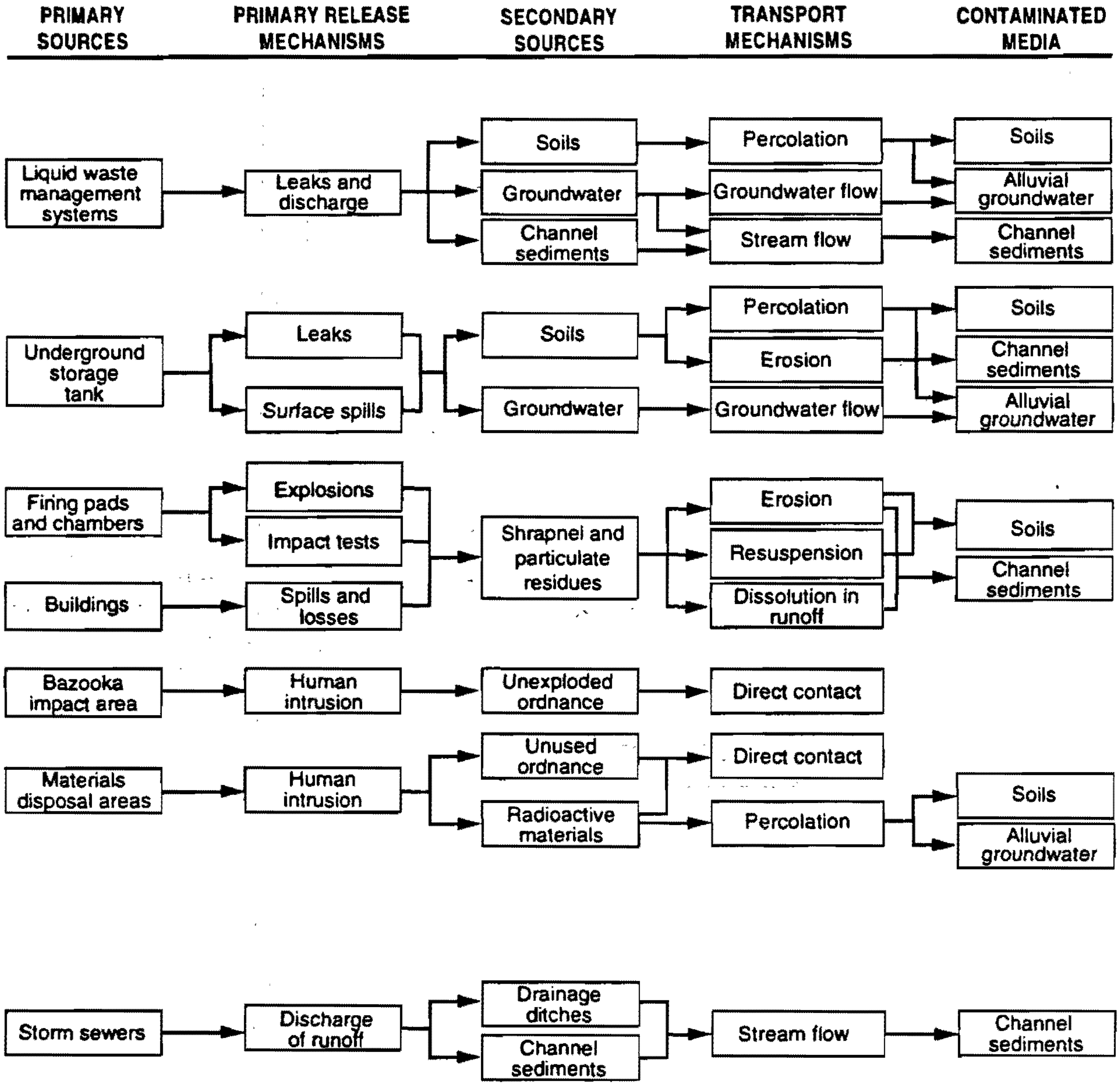


Figure 4-3. Pathways model.

potentially contaminated surfaces would provide a pathway for constituent movement.

Investigations within Los Alamos canyon systems have shown that a significant fraction of constituent transport occurs as particulate movement caused by surface runoff, and a lesser amount as solutes in the water (Nyhan and Hakonson 1976, 16-0038). Several radionuclides, including isotopes of plutonium and uranium, and many organic chemicals adsorb to soil particles. There is a strong tendency for many of these species to preferentially adsorb to the smaller-size fractions of the soil medium because of the greater cation-exchange capacity, larger specific surface area, and larger total surface area of these soil particles compared with other size fractions. In Los Alamos area canyons, the <53 mm soil size fractions typically have 10 times higher total plutonium concentrations than the 2- to -23 mm-particle sizes (Nyhan and Hakonson 1976, 16-0038). Hydrologic studies indicate that the silt-to-clay (<53 mm) size fraction is also the most mobile particle size fraction and moves readily with storm water and snowmelt runoff. The greatest adsorbed constituent mass is associated with the coarser size fractions because these size fractions compose the majority of total soil mass in canyon alluvium. This material has also been demonstrated to be mobile during summer storm events (ESG 1981, 0424). Thus, sediments in drainage channels provide a secondary source for constituents that may have been eroded from nearby surfaces, or for constituents discharged to the drainage from outfalls.

4.3.2.2 Atmospheric Transport

None of the PRSs within OU 1093 are existing air pollutant sources (i.e., stacks, vents, etc.). Previously deposited surface contamination could be resuspended by wind and moved to other locations downwind. All PRSs with potential surface contamination are presently vegetated by natural or introduced grasses and trees, or have been paved. Often the soil surface is not the original, but has been regraded as a result of facility construction. The vegetation, by covering the soil surface, significantly reduces the potential for resuspension and transport of constituents, and the reworked soil may contain lower constituent concentrations than were originally present at the surface.

4.3.2.3 Subsurface Transport in the Vadose Zone

The water table in the alluvial (perched) groundwater body at the site is known to vary in depth from 10 to 20 ft below the land surface (Section 3.6.2.2). This depth varies seasonally by as much as 10 ft in some areas. This seasonal variation results from percolation of precipitation and from recharge through the stream channels. Any constituents present in the vadose zone between the water table and the land surface could be moved downward by infiltrating precipitation, with a potential for entering the perched groundwater body. Because of relatively low surface slopes and the relatively high permeability of the alluvial material, percolating water will tend to move downward rather than laterally within the vadose zone. The extent of such movement is dependent on the solubility of the constituents, their ability to sorb on soil particles, the mobility of unbound soil particles, and the flux rate of percolating water. Subsurface constituent sources within the zone of annual water table fluctuation could alternately be releasing constituents directly to the saturated zone or to the vadose zone.

4.3.2.4 Subsurface Transport in the Saturated Zone

To a first approximation, the water table in the saturated alluvium reflects the slope of the land surface and is accordingly nearly flat. Thus, the expected horizontal hydraulic gradients in the perched groundwater body are approximately 0.03 ft/ft. One-time measurements of permeability and groundwater gradients near Kiva 1 (TA-18-23) suggest groundwater velocities in the range of 0.001 ft/day (LATA 1991, 16-0005). The velocity could change on a seasonal basis in response to changes in the configuration of the water table. Any soluble constituents that are not reactive with the alluvium (such as nitrates or chlorides) would move at approximately the same rate as the groundwater. Any materials that are sorbed (such as most radioactive elements) will move at a slower rate; however, the <53 mm soil size fraction can remain mobile in the subsurface, allowing the continued migration of adsorbed constituents (ESG 1981, 0424). Further, the <2 mm size fraction can remain highly mobile in the saturated zone, permitting adsorbed constituents to move at rates similar to nonretarded constituent species (Penrose, et. al 1990, 0174). If liquids, such as chlorinated solvents, are present in the saturated zone in undiluted form, they will sink through the saturated zone as a separate plume and accumulate above the shallowest low-permeability layer. Lower concentrations of such constituents will be present in the groundwater near this sinking plume. The concentration of all dissolved constituents in the groundwater would be gradually reduced in the direction of flow away from a constituent source due to dispersion and dilution and by sorption for reactive constituents.

4.3.3 Potential Impacts

This section discusses how humans could potentially be exposed to site-related chemicals of potential concern in the absence of site remediation, and presents the conceptual site model. Currently, the land is used for Laboratory operations; therefore, onsite workers represent the only potentially exposed population. Future land use at OU 1093 could encompass continued Laboratory operations and recreational user, which will be evaluated in a baseline risk assessment, if necessary. Residential use is not considered a potential future land-use scenario for this operable unit. The major migration pathways and relevant environmental media through which human exposure could occur are summarized in Table 4-2.

4.3.3.1 Conceptual Site Model

The onsite conceptual models identify historical sources of contamination, historical migration and conversion, potential current sources of contamination, release mechanisms, contact media, and exposure routes for each PRS. Conceptual exposure models are used to illustrate how chemicals can move in the environment from potential release sites to human receptors. They are used to help identify appropriate media and locations for sampling and to determine if

TABLE 4-2

SUMMARY OF CONCEPTUAL MODEL ELEMENTS

Pathways/Mechanisms	Concept/Hypothesis
Historical Sources	Operations/processes that contributed to the creation of the PRS (i.e., storage areas, etc.)
PRS Release Mechanism	Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, leaching, dumping, or disposing into the environment
Migration Pathway/ Conversion Mechanism	
Atmospheric particulate dispersion	Entrainment is limited to contaminants in surface soils
	Entrainment and deposition are controlled by soil properties, surface roughness, vegetative cover and terrain, and atmospheric conditions
Volatilization	Volatilization occurs to VOCs in surface soils, subsurface soils, subsurface water, perched water, or groundwater
Surface water runoff/surface water	Precipitation that does not infiltrate or evaporate will become surface runoff
	Surface runoff may carry contaminants beyond the operable unit boundary
	Surface runoff may resuspend contaminants
	Contaminated surface runoff may infiltrate the canyon-bottom alluvium
	Contaminated surface runoff may infiltrate the shallow groundwater and/or surface water
Groundwater	Groundwater may carry contaminants to the surface water (wetland areas)
	Groundwater may carry contaminants beyond the operable unit boundary
Sediments	Chemical transport by surface runoff can occur in solution, sorbed to suspended sediments, or as mass movement of heavier bed sediments
	Surface soil erosion and sediment transport are a function of runoff intensity and soil properties
	Contaminants dispersed on the soil surface can be collected by surface water runoff and concentrated in sedimentation areas in drainages
	Erosion of drainage channels can extend the area of contaminant dispersal in the drainage
	Surface runoff discharged to the canyons may infiltrate into sediments of channel alluvium
Infiltration (percolation)	Infiltration into surface soils depends on the rate of precipitation or snowmelt, antecedent soil water status, depth of soil, and soil hydraulic properties
	Infiltration into the tuff depends on the unsaturated flow properties of the tuff
	Joints and fractures in the tuff may provide additional pathways for infiltration to enter the subsurface regime
Potential Release Mechanism	
Leaching	Storm water/snowmelt can dissolve contaminants from soil or other solid media, making them available for contact
	Water solubility of contaminants and their relative affinity for soil or other solid media affect the ability of leaching to cause a release
	Leaching and subsequent resorption can extend the area of contamination
Soil erosion	The erosion of surface soils is dependent on soil properties, vegetative cover, slope and aspect, exposure to the force of the wind, and precipitation intensity and frequency
	Depositional and erosional areas exist, and erosive loss of soil may not occur in all locations
	Storm water runoff can mobilize soils/sediments, making them available for contact

TABLE 4-2 (concluded)

SUMMARY OF CONCEPTUAL MODEL ELEMENTS

Pathways/Mechanisms	Concept/Hypothesis
Potential Release Mechanism	
	Storm intensity and frequency, physical properties of soils, topography, and ground cover determine the effectiveness of erosion as a release mechanism
	Erosion may also enlarge the contaminated area
Mass wasting	The rate of the process is extremely slow
Resuspension (wind suspension)	Wind suspension of contaminated soil/sediment as dust makes contaminants available for contact through inhalation/ingestion
	Physical properties of soil (e.g., silt content, moisture content), wind speed, and the size of the exposed ground surface determine the effectiveness of wind suspension as a release mechanism
	Wind suspension can enlarge the area of contamination and create additional exposure pathways, such as deposition on plants followed by plant consumption by humans or animals
	Manual or mechanical movement of contaminated soil during construction or other activities makes contaminated soil available for dermal contact, ingestion, and inhalation as dust
	The method of excavation (i.e., type of equipment), physical properties of soil, weather conditions, and magnitude of excavation activity (i.e., depth and total area of excavation) influence the effectiveness of excavation as a release mechanism
Excavation	Excavation can increase or decrease the size of the contaminated area, depending on how the excavated material is handled
	Excavation activities may move subsurface contamination to the surface and generate dust
	Excavation activities may liberate VOCs in subsurface soils
Exposure Route	
Inhalation	Vapors, aerosols, and particulates (including dust) can be inhaled
	Physical, chemical and/or radioactive properties of airborne contaminants influence their degree of retention in the body after inhalation
Ingestion	Ingestion of soil, water, food, and dust can lead to chemical intake
Direct contact	Some contaminants will absorb through skin that is in contact with the contaminated surfaces of soil, tuff, or rubble
	Matrix effect (the type of media in which the contaminant is located may affect its bioavailability)
External penetrating radiation	External, or whole body radiation, can occur through exposure to gamma-ray-emitting radionuclides that may be present in soil, either directly through the soil or re-entrained as dusts
	Exposure to penetrating radiation can also occur through inhalation or ingestion when radionuclide-contaminated soil or tuff surfaces erode and/or dusts become re-entrained

the PRS poses a threat to human health or the environment. Elements of the conceptual models are presented in Table 4-2.

The conceptual models for OU 1093 are formulated on available PRS information only. Further refinement of the conceptual models or development of separate models may be necessary based on data gathered through the RFI investigation.

4.3.3.2 Potential Human Exposure

All of the sampling plans considered for OU 1093 compare soil or water samples to screening action levels to identify the presence of potential contaminants of concern. As mentioned in Section 4.2.2, screening action levels are based on a conservative, residential exposure scenario. If soil or water is found to be contaminated (concentrations of potential contaminants of concern are above screening action levels) in Phase I or Phase II, the human exposure to these contaminants will be quantified in a baseline risk assessment. Human exposure is estimated through a model of the reasonably maximum exposed individual, which is defined through assumptions of current and future land use (EPA 1989, 0305). Two exposure scenarios will be evaluated in baseline risk assessments for OU 1093: continued Laboratory operations (current and future) and recreational use (future only). The residential exposure scenario is not applicable for baseline risk assessments at OU 1093 because, after decommissioning, the land at OU 1093 is not expected to be used for residential purposes.

Refer to Section 4.3 of the 1992 IWP for ER Programmatic guidance on probable land-use scenarios (LANL 1992, 0768). Dependent on site-specific parameters (e.g., types of contaminants present or migration potential), the worst-case exposure scenario may vary. For PRSs where two scenarios may be applicable, two baseline risk assessments will be calculated to determine the more conservative exposure scenario. For any baseline risk assessment, the 95% upper confidence limit on arithmetic average concentration of potential contaminants of concern in exposure areas, either surface or subsurface soils, is sufficient to determine receptor exposures. Assumptions made for continued Laboratory operations and recreational scenarios follow.

4.3.3.2.1 Continued Laboratory Operations

In the foreseeable future, land is likely to continue to be used for Laboratory operations. Future land-use scenarios for continued Laboratory operations include populations of office workers (individuals who work on or near the site) and construction/maintenance workers (individuals who would be exposed to surface and subsurface soils through excavation). Office workers and construction workers are estimated to be the most likely reasonably maximum exposed individuals and are, therefore, the exposure scenarios that will be evaluated under the land-use scenario of continued Laboratory operations.

Office workers are expected to be exposed routinely to contaminated surface media. Surface contamination above screening action levels will be evaluated in a baseline risk assessment using the office worker scenario. Both current and future risks can be evaluated using the office worker scenario.

The construction/maintenance worker scenario is considered to be the most conservative exposure scenario for PRSs in OU 1093 that consist of surface and subsurface contamination. PRSs in OU 1093 that consist of surface and subsurface contamination above screening action levels will be evaluated for future risks in a baseline risk assessment using the construction worker scenario.

Exposure pathways relevant for office workers include inhalation of dust and volatile compounds in the workplace, incidental ingestion of soil and dust, and whole body radiation. Exposure pathways relevant to workers engaged in construction activities that disturb the soil include (1) inhalation of fugitive dust or volatile compounds, (2) incidental ingestion of contaminated soils, (3) direct dermal contact with contaminated soils, (4) whole body radiation, and (5) contact with explosives (Table 4-2).

4.3.3.2.2 Future Recreational

When this site is decommissioned in the future, OU 1093 could be released for recreational use. The recreational scenario excludes agriculture, but considers camping, hiking, hunting, and, possibly, limited construction. Any PRS in OU 1093 with surface contamination (0 to 6 in.) above screening action levels will be evaluated in a baseline risk assessment using the recreational scenario.

Recreational users of the area could come into contact with contaminants through ambient air, surface soil, sediments in drainage channels, and pooled surface water. Exposure pathways associated with recreational activities include (1) inhalation of fugitive dust, (2) incidental soil ingestion, (3) dermal contact with soil, (4) contact with explosives, (5) whole body radiation, and (6) dermal contact with surface water (Table 4-2).

Campers are assumed to carry in potable water and food; therefore, exposure through consumption of contaminated edible plants (pinon nuts, berries, etc.) or drinking water are nonsignificant pathways in the recreational scenario. No body of water large enough to support a consistent supply of game fish exists at OU 1093.

4.4 Potential Response Actions and Evaluation Criteria

This section presents all remedial alternatives (other than the VCAs described in Section 4.2.3) that are under consideration for the PRSs in OU 1093. The discussion of the remedial alternatives will focus on the data required as a result of the Phase I investigations that would be needed to design the Phase II investigation or CMS.

4.4.1 Criteria for No Further Action

PRSs proposed for NFA are addressed in Chapter 6 of this work plan and listed in Table 1-4. Consistent with the decision logic presented in Figure 4-1, some sites are proposed for NFA on the basis of information obtained from the archival data search, and other sites may be proposed for NFA at the end of Phase I, Phase II investigations, or CMS. The following criteria are used in making those recommendations:

> **Criterion 1.** There is no evidence of any contaminant release from the identified PRS.
>
> **Criterion 2.** Based on Phase I data or other reliable data that may be available, it is established that the concentrations of the contaminants of concern are below screening action levels. NFA recommendations based on screening assessments will include an evaluation of the combined effects from multiple contaminants and ALARA criteria for radioactive contaminants.
>
> **Criterion 3.** The risk, as determined by a baseline risk assessment, is less than 10^{-4} to 10^{-6} for carcinogens, and the hazard index is less than one for noncarcinogens. These NFA recommendations will also consider ALARA criteria for radioactive contaminants.
>
> **Criterion 4.** The PRS is unlikely now, or in the future, to release contaminants to the environment, and receptors are unlikely to be exposed to any contaminants.

4.4.2 Soil Removal and Treatment and/or Disposal

This alternative is applicable to areas of limited soil contamination, such as at firing sites or contaminated sediments in surface drainage-ways.

4.4.2.1 Description of Alternative

This alternative would involve excavation of contaminated soil (i.e., above screening action levels). If hazardous constituents are present, the soil could be treated to eliminate the contaminants or to reduce the concentration of constituents to acceptable levels for disposal at a RCRA-permitted treatment, storage, and disposal facility. Land disposal restrictions (EPA 1991, 0886) may need to be addressed as part of determining the acceptable level. If radionuclides are present, the excavated soil would be disposed of in a radioactive or mixed waste disposal facility.

4.4.2.2 Data Requirements for Designing a Phase II Investigation

If Phase I investigations establish that contaminants of concern are present in subsurface soils, surface soils, and groundwater at concentrations above screening action levels, and there is insufficient data to conduct a baseline risk assessment, a Phase II investigation would be conducted. A Phase II investigation would establish the full extent of contamination within the vadose zone and any underlying saturated zones. Phase I investigations should, therefore, provide data on the constituents present in the subsurface soil, surface soil, and groundwater, and the approximate physical extent of the contamination.

The sampling will be biased to detect contaminants. For example, if subsurface soils are above background concentrations and below screening action levels, and the groundwater has not been sampled in Phase I, a Phase II groundwater investigation will be conducted (Figure 4-2).

4.4.3 Excavation of Buried Wastes

This alternative is potentially applicable to locations where wastes have been buried and may be the only alternative for geomorphically unstable sites.

4.4.3.1 Description of Alternative

Buried waste materials or contaminated subsurface structures, such as septic tanks and any surrounding contaminated soil, would be excavated, containerized, and treated or disposed of as appropriate. The treatment and disposal alternative would be similar to the one described in Section 4.4.2.1.

4.4.3.2 Data Requirements for Designing Phase II Investigations

Data requirements for designing Phase II investigations are similar to those identified in Section 4.4.2.2. For buried waste, the physical location of the buried material needs to be established, as well as the approximate boundaries of the excavation. Contaminated structures would generally be located by a continuing excavation. Before sampling of the waste and potentially contaminated soil can be initiated, it will be necessary to characterize any safety hazards associated with sampling the waste materials.

4.5 Sampling Strategies and Sampling Methods

4.5.1 Sampling Strategies

Field investigations during Phase I will involve many approaches that will be applied to more than one PRS or PRS aggregate. The following sections describe these approaches.

4.5.1.1 Location Surveys

Before sampling can be initiated, it will be necessary to establish the actual location of all surface and subsurface structures or features associated with a PRS, including facility drain lines, septic tanks, leach fields, outfalls, waste disposal pit boundaries, etc. This will be accomplished by visual inspection, followed as necessary by engineering field surveys to locate and mark the position of all subsurface structures and lines based on as-built drawings. When as-built drawings are unavailable, or if doubt exists as to the accuracy of the available drawings, other location methods may be used to establish the extent of these subsurface structures. These methods may include geophysics or trenching. The ER Program is currently conducting a comparative analysis of alternative techniques for locating leach fields and other subsurface structures.

The location surveys will also identify the position of all subsurface utilities near each PRS, including electrical, water, gas, air, telephone, or vacuum lines. This will be accomplished in cooperation with the Laboratory Facilities Engineering Division.

4.5.1.2 Geophysical Surveys

Unexploded ordnance, at or below the ground surface, or buried metallic items may be present in some PRSs in OU 1093. Sweeps for surface evidence of unexploded ordnance have been conducted at all such sites, but some could remain in the subsurface. At other PRSs, such as septic systems, subsurface components of the system will need to be located to properly identify sampling positions. The accuracy of existing engineering drawings cannot be established. Geophysical surveys can be used to locate any subsurface metallic items, such as pipes or tanks, where the exact location of subsurface material is uncertain. Such material is best located through the use of geophysical surveys, rather than by trenching. Geophysical survey methods, such as electromagnetic induction, magnetometry, or ground-penetrating radar, can detect the presence of near-surface buried metallic material or of nonmetallic materials whose physical properties are different from those of the surrounding soils. The particular method selected and how it is applied depends on the expected size and depth of the subsurface material and on the physical characteristics of the subsurface material and surrounding soils. The specific data requirements for geophysical surveys will be addressed in the respective sampling plans in Chapter 5.

4.5.1.3 Statistical Basis for Sampling Strategies

The principal goal of reconnaissance investigations, such as those performed in Phase I, is to detect contamination present over a substantial portion of a relatively small area. The decision whether further consideration of the area is necessary is based on the highest concentration of a particular constituent of concern measured in the collected samples. A single concentration above screening action levels will be taken as sufficient reason to warrant further consideration, perhaps leading to a Phase II sampling program. For some situations, it is reasonable to assume that the presence of constituent concentrations above screening action levels is equally likely at any location within a region potentially affected by a release. This would include judgmental sampling in a stream channel, within a drain field, or beneath a tank. For such a situation, it is possible to determine the probability that a particular sample will contain constituents above prespecified screening action levels if contaminants are present over some fraction of the sampled region. Table 4-3 shows the number of samples, N, required to establish with at least probability, P, that at least a fraction, f, of the area is contaminated above a prespecified concentration (Barnes 1988, 0797). The table is based on the following relation:

$$P = 1 - (1-f)^N \qquad (4\text{-}1)$$

TABLE 4-3

SAMPLE SIZES FOR RECONNAISSANCE SAMPLING

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

(Field duplicates should not be counted in applying Equation 4-1, which assumes N independent observations.) Thus, five sampling locations can provide at least a 95% probability of detecting contamination that affects at least half of the area, but a lower probability (75%) of detecting contamination that affects only 30% of the area. This formula provides insight into the representiveness of sampling, but does not, in any way, a priori presume that a particular fraction of the site is contaminated. Phase I investigations will propose four or fewer samples for situations where it is reasonable to assume that contamination, if present, is present in substantially more than half the area. Five or more samples will be collected in areas where the spatial distribution is uncertain or unknown.

4.5.1.4 Sampling Strategy for Septic Systems

The decision process that was applied to developing Phase I sampling plans for septic systems is presented in Figure 4-1. For all septic systems in OU 1093, no data are available to indicate that contaminants are present in the septic tanks and associated drain fields. (Recall that a contaminant is defined as a constituent present at concentrations above screening action levels.) For some of the septic systems, occasional releases of radioactive or hazardous constituents to the drain field may have occurred, and regular discharges of 2 may have occurred for one or more of the septic systems. (These instances are addressed in Chapter 5.) However, it is anticipated that most or all of the septic tanks and associated drain fields will not contain concentrations of radioactive or hazardous constituents above media-specific screening action levels. Therefore, Phase I investigations of all inactive septic systems will be screening assessments to establish the presence or absence of hazardous and radioactive contaminants. Phase I investigations of active septic systems will be designed to estimate the current risk associated with the systems. Current risk can be evaluated by comparing measured surface soil concentrations of potential contaminants of concern against screening action levels, or by conducting a baseline risk assessment (Section 4.3.3.2). Full characterization will be deferred until the systems are deactivated, unless current health risks mandate some corrective action. Using the results of the Phase I investigation, a decision will be made as to whether a recommendation can be made for NFA, CMS, VCA, or a deferred action. The decision logic for this process is illustrated in Figure 4-2.

4.5.1.4.1 Active Septic Systems

Three septic systems in OU 1093 are active, and no schedule has been established for their deactivation. For these active systems, sampling will be restricted to determining the current health risks associated with the tanks and drain fields. Full characterization of the septic system will be deferred until it is deactivated, providing that current risks are acceptable. The basis for establishing current risks is presented in Section 4.3.3.2.

Sampling will have the objective of determining concentrations of potential contaminants in the surface soils, in sediments associated with any outfall from the drain field, and in the shallow groundwater in the immediate vicinity of the active systems. To augment this information, the contents of the tank will also be sampled. Soils and sediments provide a pathway for exposure of present site personnel. Shallow groundwater provides a potential pathway for offsite migration of contaminants. If Phase I sampling should indicate that current risks are unacceptable, consideration will be given to conducting a VCA as part of a Phase II investigation.

4.5.1.4.2 Inactive Septic Systems

Sampling of inactive septic systems will have the objective of determining the presence or absence of contaminants in all portions of the systems: the tank, drain field, associated soils, outfalls (if present), and underlying shallow groundwater. If the analysis of the tank contents, adjacent soils, drain field soils, and groundwater indicates that no contaminants of concern are present, and no additional concerns such as multiconstituent risks are present, NFA will be proposed for the septic system (Section 4.1.4, IWP [LANL 1992, 0768]). If analytical results indicate that the tank is above media-specific screening action levels, consideration will be given to performing a VCA (Section 4.2.3). The planning of a VCA will require data on concentrations of potential contaminants within the drain field associated with the septic tank (Section 4.5.1.5). Samples will be obtained by collecting cores from the drain field soils; however, it may prove more cost-effective to collect sufficient data for a baseline risk assessment of the septic system than to conduct a VCA based only on Phase I data. The possible conduct of a VCA for inactive septic systems will be addressed in a Phase I report in which a Phase II investigation, either incorporating a VCA or directed at obtaining data for a baseline risk assessment, would be proposed.

When removal of a tank and/or associated drain field soils would create significant site disruption, removal may be delayed until site decommissioning (Section 4.2.3), provided there is no current risk to onsite or offsite receptors. For any septic systems where deferral of a VCA is proposed, data on surface soils, and possibly additional groundwater data for assessing current risk, would be developed in a Phase II investigation (Section 4.5.1.8).

4.5.1.5 Sampling Strategy for Drain Fields

The position of drain fields associated with septic tanks will be established with engineering surveys based on existing engineering drawings. Field evidence, such as the location of outfalls or surface depressions, will be used to confirm the location of the drain fields. Ground-penetrating radar will also be used to confirm the location of drain fields and associated piping. Sampling of soils within the drain fields will have the objective of determining the presence or absence of contaminants to a depth of 10 ft. Contamination within that depth interval might reasonably be expected to be brought to the surface through future excavations at the site.

For inactive drain fields, soils potentially affected by effluent discharges will be sampled, and samples will be taken of underlying shallow groundwater (if present). For active drain fields, sampling will address surface soils and the shallow groundwater underlying the drain field. In both instances, the groundwater data will be used to evaluate current risk from past discharges to the drain fields. For inactive septic systems, measured concentrations of potential contaminants of concern in drain field soils and groundwater will be compared with media-specific screening action levels. If the comparison indicates that concentrations of potential contaminants present an acceptable health risk, NFA will be proposed for the drain field.

For inactive drain fields, if measured concentrations of potential contaminants of concern in alluvial groundwater are below screening action levels, but soil constituent concentrations are above screening action levels, a baseline risk assessment will be performed to determine if a VCA is appropriate (Section 4.2.3). The plan for any proposed VCA would incorporate sampling results from the septic tank(s) associated with the drain field, and would be presented in a Phase I report. As described in Section 4.5.1.4, a VCA would only be proposed if it did not result in significant site disruption. If such disruption were to occur, a Phase II investigation to sample surface soils and further sample groundwater beneath the drain field would be proposed in the Phase I report. This Phase II investigation would be directed at determining whether the current risk associated with the septic tank and drain field is acceptable.

If measured concentrations of potential contaminants of concern in alluvial groundwater are above screening action levels, a Phase II investigation of groundwater will be proposed. In such a case, a VCA for the septic system would not be considered until completion of the Phase II investigation. If potential contaminants are present in the drain field soils above background (or practical quantitation limits [PQL] for constituents with zero background concentrations), a groundwater investigation specific to that septic system will be proposed as a Phase II investigation (Section 4.5.1.8).

4.5.1.6 Sampling of Surface Outfalls

Discharges from outfalls other than storm sewers are small and infrequent. With two exceptions, no intentional discharge of potential contaminants has occurred directly to an outfall. Photochemical wastes were reportedly discharged through one outfall and may have reached a second outfall associated with a septic system drain field.

For surface outfalls associated with septic systems, and for all other outfalls, sampling will have the objective of investigating the presence or absence of potential contaminants in soils and sediments downstream from the outfalls. In most instances, the outfall drainages discharge directly into the main drainage channel in either Pajarito or Threemile canyons, within less than 50 ft of the outfall. Flows in these outfall drainage channels are small and infrequent, and would not be expected to move significant amounts of sediment to the main drainage. Flows in the main drainage, however, are frequently large and could redistribute potential contaminants to downstream areas. Sampling locations associated with the outfall will be selected to provide data on the possible presence of potential contaminants discharged from the outfall. The possible presence of contaminants in downstream portions of this operable unit will be investigated as part of the Canyons Operable Unit.

4.5.1.7 Phase I Investigation of Shallow Groundwater

As described in Section 5.6, three shallow monitoring wells (PCO-1, -2, and -3) in the alluvium in Pajarito Canyon are sampled and analyzed annually as part of the Laboratory's environmental monitoring programs. Well PCO-1 is just east of TA-18, PCO-2 is east of the inactive sewage lagoons, and PCO-3 is further east towards White Rock. Water analyses reported in the 1989 and 1990 environmental monitoring reports (Environmental Protection Group 1990, 0497; Environmental Protection Group 1992, 0740) demonstrate that the shallow groundwater, if it would serve as a water supply, should be considered potable, and that no evidence of contamination by radiochemical or chemical parameters was observed (Section 5.6); however, the suitability of this aquifer as a water supply has not been evaluated.

PCO-1 and -2 are ideally situated to detect the presence of possible contaminants released to the shallow groundwater body from operations at TA-18, from the sewage lagoons, or from former firing sites at TA-27. Consistently low or undetected concentrations of potential contaminants in these wells would suggest that no significant contamination has occurred.

To more fully respond to the concerns over the potential for contamination of shallow groundwater near TA-18, wells PCO-1 and -2 will be included in the Phase I sampling for OU 1093, but no new wells will be constructed. Well PCO-3 will be included in investigations conducted by the Canyons Operable Unit. While existing data are believed to be correct and reliable, inclusion of these wells will produce data with quality assurance protocols identical to those of all other ER Program data. Further, existing data do not address all potential contaminants of concern for this operable unit. Discussion of existing data and details of the proposed sampling are presented in Section 5.6.

4.5.1.8 Phase II Soil and Alluvial Groundwater Investigations

Groundwater sampling is planned for Phase I for some, but not all PRSs. Several conditions could require a Phase II investigation of soil and/or alluvial groundwater.

First, for PRSs where no Phase I sampling is performed, the presence of potential contaminants in the soil at measurable concentrations, even if below screening action levels, would raise concern over the possibility of contamination of underlying shallow groundwater, if such is present. Screening action levels are media-specific, and the fact that potential contaminant concentrations in soils are below screening action levels does not indicate that the underlying groundwater has not been impacted by discharges from the septic system. Background (or PQLs for constituents with zero background concentrations) was selected as a criterion for this decision because, based only on Phase I sampling data, no higher soil concentration can be justified for all potential contaminants as an indicator of no threat to groundwater.

Second, if the results of Phase I sampling suggest that a VCA is appropriate, it may be desirable to defer the VCA because significant site disruption would be associated with it. This disruption might, for example, include the removal or disruption of existing surface features, such as security fences, whose presence would impede or prohibit the VCA. To defer a VCA, it will be necessary to demonstrate that current risks associated with a PRS are acceptable. As described in Section 4.3.3.2, assessment of current risk requires data on potential contaminant concentrations in surface soils. Shallow groundwater near the PRS must be addressed to establish whether contaminant transport may be occurring.

Third, Phase I sampling of groundwater, either specific to a PRS or for the overall operable unit, could demonstrate that some potential contaminants of concern in groundwater exceed screening action levels. This condition would mandate a Phase II investigation to establish the source and extent of the observed contamination.

Finally, Phase I investigations could reveal extensive areas of soil contamination above screening action levels. In such instances, a VCA may not be appropriate, and a Phase II investigation of both soil and groundwater may be required to better select either a VCA or a CMS.

Specific designs for these Phase II soil and groundwater investigations would be presented in the Phase I report.

4.5.1.9 Phase I Investigations of Wetland Areas

As discussed in Section 3.3.4, the drainage in Pajarito Canyon east of TA-18 contains a significant area potentially classified as wetlands. (Formal delineation of wetland areas in Pajarito Canyon has not occurred [Section 4.7.1.2].) Transport of potential contaminants of concern present in the stream channel, either as a result of operations within this operable unit or from upstream areas, could have resulted in accumulations of these contaminants in the wetland areas. Sediments and surface water in the wetland areas will be sampled as part of Phase I investigations (Section 5.7).

4.5.2 Sampling Methods

The following Laboratory ER standard operating procedures (SOPs) will be using during field investigations in OU 1093. These SOPs are presented in the Environmental Restoration Standard Operating Procedures (LANL 1991, 0411).

04.01	Drilling Methods and Drill Site Management
06.09	Spade and Scoop Method for Collection of Soil Samples
06.10	Hand Auger and Thin-Wall Tube Sampler
06.19	Weighted Bottle Sampler for Liquids and Slurries in Tanks

The following SOPs will be used during field investigations at OU 1093, but have not been formally approved by the Laboratory's ER Program. They are included in this document as Appendix C. These procedures, or the equivalent, will be formally adopted before the start of field investigations.

C-6	Use of Hollow Stem Auger (for Boring and Subsurface Soil Sampling)
C-7	Collection of Sludge Samples from Tanks Using the Hand Corer (as contained in SOP for Soil and Sediment Sampling)

The type and minimum number of quality control samples are specified in the generic Quality Assurance Project Plan (QAPjP), as incorporated in Annex II. To enhance the understanding of variability among samples, and for further understanding of variability in the analytical process, a decision has been made to increase the number of quality control samples from 1 in 20, as recommended in the QAPjP, to 1 in 10. The proposed numbers of quality control samples are presented in Table 4-4. The specific numbers of field duplicate, rinsate blanks, and field blanks that will be collected are tabulated in the respective sections of Chapter 5. Reagent blanks and trip blanks will be submitted with each shipment in accordance with the QAPjP, but are not identified in the sampling plans in Chapter 5.

4.6 Analytical Methods

4.6.1 Field Surveys

The following SOPs will be used in field survey work. They have not been formally adopted by the ER Program and are, therefore, included as part of this document in Appendix C. These procedures, or the equivalent, will be formally adopted before field investigations begin.

C-1	Collection and Radiological Screening of Wipe Samples from Surfaces
C-2	Near Surface and Soil Sample Screening for Low-Energy Gamma Radiation Using the FIDLER
C-3	Beta-Gamma Radiation Measurements Using a Geiger-Mueller Detector
C-4	Screening Soil Samples for Alpha Emitters
C-5	Monitoring of Organic Vapors with a Photo Ionization Detector
C-8	In Situ Groundwater Sampling by Hydropunch
C-9	Groundwater and Surface Water Sampling
C-10	Field Measurement of Total Petroleum Hydrocarbons Using the Hanby Method

TABLE 4-4

RECOMMENDED LEVEL OF QUALITY CONTROL SAMPLES FOR FIELD SAMPLING

Sample Type	Applicable Matrix	Sample Frequency
Field blank	Water	1 per 10 samples
Field duplicate	Soil and water	1 per 10 samples
Rinsate blank	Soil and water	1 per 10 samples
Reagent blank	Soil and water	1 per 10 samples
Trip blank	Water	1 per shipping container for VOC analysis only

4.6.2 Mobile Laboratory Methods

The ER Program is developing mobile laboratories for analysis of radiological and nonradiological constituents in environmental samples. To date, the main application of the mobile radiological laboratory has been for screening samples before shipment to a fixed analytical laboratory. Stipulated detection limits for the radiological laboratory are given in Table 4-5. Screening action levels for radiological constituents have not been formally established, so it is not possible to stipulate minimum detection limits necessary to compare environmental concentrations with screening action levels. However, as indicated in Table 4-4, proposed screening action levels for soils are all comparable to or substantially less than detection limits for the mobile laboratory.

The nonradiological mobile laboratories are still under development. Anticipated detection limits for selected inorganics (metals), VOCs, and SVOCs are presented in Table 4-4, and are compared with screening action levels. For conclusive proof regarding the presence or absence of potential contaminants at screening action level concentrations, it is desirable that detection levels be approximately 1/10 of the screening action levels. As shown in the table, detection limits for beryllium, cadmium, and mercury are not adequate for confirming the presence or absence of potential contaminants at screening action levels. Similarly, some VOCs and SVOCs may not be conclusively detected at screening action levels. In addition, the mobile laboratories have not been fully qualified to provide data equivalent to that from a fixed analytical laboratory. (The Laboratory is seeking such qualification.) Thus, at present, any proposals for NFA must be supported by data from a fixed analytical laboratory.

For constituents where detection levels are at or below screening action levels, the mobile laboratory provides a valuable screening process to select preferred sampling locations. Thus, for PRSs that may contain such constituents, samples will be selected at numerous locations within the area to be sampled and analyzed in the mobile laboratory for metals, VOCs, and SVOCs. Samples will then be selected from locations showing the highest concentrations for submission to the analytical laboratory. The specific details on how this duplicate or split sampling will occur will vary among PRSs and as a function of the constituent. These details are presented in the respective sections of Chapter 5.

TABLE 4-5

COMPARISON OF SCREENING ACTIONS LEVELS WITH MOBILE LABORATORY DETECTION LIMITS

Potential Contaminant	Mobile Laboratory Detection Limits (soils)		Screening Action Levels (soils)
Metals	XRF[a] (ppm)		(ppm)
Barium	10		5,600
Beryllium	ND[b]		0.16
Cadmium	2		0.4
Chromium	8		400
Mercury	30		24
Silver	1		400
Uranium	10		240
Volatile Organics	GC/HALL/PID[c] (ppb)		(ppb)
Acetone	50		8,000,000
Benzene	10		670
Carbon tetrachloride	10		210
Tetrachloroethane	10		590
Toluene	10		890,000
Trichloroethane	10		3,200
Vinyl chloride	10		13
Xylenes	10		160,000,000
Radionuclides	Gross α/β (pCi/g)	Gross γ (pCi/g)	(pCi/g)
Cobalt-60		4	0.9
Cesium-137		4	4
Plutonium-238	55		27
Plutonium-239	55		24
Strontium-90	55		8.9
Thorium-232	55		0.9
Uranium-233	55		86
Uranium-235	55		18
Uranium-238	55		59

a. X-ray fluorescence (XRF).
b. No detection limits established.
c. Gas chromatography.

TABLE 4-6

COMPARISON OF SCREENING ACTION LEVELS WITH PRACTICAL QUANTITATION LIMITS FOR AVAILABLE ANALYTICAL METHODS

	Soil				Water		
Compounds	**SAL**[i] (mg/kg)	**PQL** (mg/kg)	**Back-ground in Soil** (mg/kg)[a]	**PQL versus SAL**[b]	**SAL** (ug/L)	**PQL** (ug/L)	**PQL versus SAL**[b]
Inorganics[c]							
Barium	5,600	0.2	120-810		2,400	2	
Beryllium	0.16	0.03	1-3		0.0081	0.3	X
Cadmium	80	0.4			35	4	
Chromium III	80,000	0.7			50	7	
Chromium IV	400	0.7			50	7	
Cyanide	1,600	5			200	10	
Lead	500	4.2	8-98		50	42	X
Mercury	24	0.0002	0.007-.029		2	0.02	
Nickel	1,600	1.5			700	15	
Silver	400	0.7	<1.6		50	7	
Uranium	240	0.0005	1.54-6.73		100	2	
Zinc	24,000	0.2			10,000	2	
Volatiles[d]							
Acetone	8,000	0.1			3,500	100	
Benzene	0.67	0.005	0		1.2	5	X
Carbon tetrachloride	0.21	0.005			0.27	5	X
Chlorobenzene	67	0.005			100	5	
Chloroform	0.21	0.005			5.7	5	X
1,1-Dichloroethane	410	0.005			25	5	
1,1-Dichloroethene	0.59	0.005			0.58	5	X
1,2-Dichloroethane	0.2	0.005			0.38	5	X
Methylene chloride	5.6	0.005			4.7	5	X
1,1,2,2-Tetrachloroethane	3.9	0.005			1.8	5	X
Tetrachloroethene	5.9	0.005			0.67	5	X
Toluene	890	0.005			750	5	
1,1,1-Trichloroethane	1,000	0.005			60	5	
Trichloroethene	3.2	0.005			3.2	5	X
Xylenes (Total)	160,000	0.005			620	5	
Semivolatiles[e]							
Acenaphthene	4,800	0.66			2,100	10	
Anthracene	24,000	0.66			10,000	10	
Bis-(2-chloroethyl)ether	0.13	0.66		X	0.032	10	X
Bis-(2-ethylhexyl)phthalate	50	0.66			2.5	10	X
Butyl benzyl phthalate	16,000	0.66			7,000	10	
2-Chlorophenol	400	0.66			170	10	
Di-n-butylphthalate	8,000	ND		?	3,500	10	
2,4-dichlorophenol	240	0.66			100	10	
Diethylphthalate	64,000	0.66			28,000	10	
2,4-Demethylphenol	1,600	0.66			700	10	
Dimethyl phthalate	80,000	0.66			35,000	10	
2,4-Dinitrotoluene	1	0.66		X	0.051	10	X
Fluoranthene	3,200	0.66			1,400	10	
Fluorene	3,200	0.66			1,400	10	

TABLE 4-6 (concluded)

COMPARISON OF SCREENING ACTION LEVELS WITH PRACTICAL QUANTITATION LIMITS FOR AVAILABLE ANALYTICAL METHODS

	Soil				Water		
Compounds	SAL (mg/kg)	PQL (mg/kg)	Background in Soil (mg/kg)[a]	PQL versus SAL[b]	SAL (ug/L)	PQL (ug/L)	PQL versus SAL[b]
Indeno[1,2,3-cd]pyrene	ND	0.66		?	ND	10	?
Naphthalene	3,200	0.66			30	10	
N-Nitrosodiphenylamine	140	0.66			7.1	10	X
Pentachlorophenol	5.8	3.3		X	0.29	50	X
Phenol	48,000	0.66	0		21,000	10	
Pyrene	2,400	0.66			1,000	10	
2,4,6-Trichlorophenol	64	0.66			3.2	10	X
Explosives[g]							
Barium nitrate	5,600	f		?	ND	f	
TNT	40/233	f		?	ND	f	
2,4-DNT	160/1	0.42		X	ND	f	
2,6-DNT	4/1	0.4		X	ND	f	
1,3-DNB	8	0.59			ND	f	
RDX	240/64	0.98			ND	f	
PETN	1,600	f		?	700	f	
Tetryl	800	0.25			ND	f	
Radionuclides[h]	pCi/g	pCi/g			pCi/L	pCi/L	
Cesium-134	1.5	0.1			NA	20	?
Cesium-137	3.2	0.1			NA	20	?
Plutonium-239	20.15	0.005			NA	0.04	?
Strontium-90	4.46	2		X	NA	3	?
Thorium-232	0.72	0.01			NA	0.1	?
Uranium-233	69.9	0.01			NA	0.2	?
Uranium-235	14.75	0.05			NA	0.2	?
Uranium-238	47.81	0.01			NA	0.2	?

a. Available background levels from a report by Ferenbaugh (Ferenbaugh et al. 1990, 0099) and Framework Studies (Longmire, in preparation, 16-0059).
b. Column indicates those constituents for which the PQL is higher than 0.1 times the screening action level.
c. EPA Method 1990.
d. EPA Method 8240.
e. EPA Method 8270.
f. PQLs were not available for these compounds.
g. US Army Toxic and Hazardous Materials Agency procedures.
h. Method documented in DOE 1983, except for plutonium-239, which uses radiochemical separation and alpha spectrometry.
i. Screening action level.
NA Screening action levels were not available for radionuclide concentrations in water.
ND Not determined.

4.6.3 Analytical Laboratory Methods

Potential contaminants of concern at OU 1093 are listed in Table 4-5. This list includes all potential contaminants specifically identified in the various sections of Chapter 5 (such as nearly all the metals and radionuclides), as well as potential contaminants that could be present based on activities at TA-18 and the former TA-27. This latter category includes most of the VOCs and SVOCs whose potential presence can be inferred from the reported use of solvents at the site, and high explosive constituents, their degradation products, and metals commonly associated with firing site activities (Section 4.3.1.1). As discussed in the respective sections of Chapter 5, there are no data indicating the actual presence of these potential contaminants in the environment above screening action levels at any locations in OU 1093.

The generic QAPjP (LANL 1991, 0553) presents analytical methods and practical quantitation limits for most potential contaminants of concern in OU 1093; however, the present version of the QAPjP does not identify analytical methods of sufficient resolution to allow their application to all potential contaminants of concern at OU 1093 (Table 4-5). (Some of the methods identified have detection limits significantly in excess of screening action levels, or do not specify detection limits for all media that will be investigated.) The QAPjP is presently under revision, and that revision is expected to contain adequate specification of the required methods. In the event that analytical methods of sufficient resolution are unavailable, quantitation limits for the best available method will be used and application of the screening action levels will be modified as necessary (see Chapter 4 and Appendix J of the IWP [LANL 1992, 0768]). For example, risk assessment guidance for Superfund investigations (EPA 1989, 0305) recommends that for constituents present at or below the PQL, half the PQL should be used as a surrogate for the actual concentration in risk assessment calculations. Using this concept, if the screening action level is below the PQL for a particular analyte, but no less than half the PQL, the PQL could be used as a surrogate for the screening action level. Alternatively, it may be necessary to perform a baseline risk assessment for analytes whose screening action level is significantly below the PQL. Results of the risk assessment, probably using half the PQL as a surrogate for the actual value, could establish whether the risk is acceptable or if improved analytical methods are necessary.

4.6.4 Field Screening Strategies

For many of the PRSs in this work plan, such as storm water outfalls, there is no visible evidence of releases, such as soil staining, and no compelling reason to believe that contaminant releases have occurred. Judgmental sampling is being proposed, with sampling locations selected to represent the most probable location of any contaminants, if they are present. However, field screening methods can be used to evaluate the possible presence of both radioactive and nonradioactive constituents and to focus sampling on areas evidencing some potential contaminant concentrations. The field screening results also provide information on the nature of any bias present in the reconnaissance sampling.

4.7 Mitigation of Impacts on Biological and Cultural Resources

The biological and cultural resource inventory (Sections 3.3 and 3.4) identified critical species and sensitive areas in OU 1093. Impacts on these species and areas will be minimized, as discussed in the following sections.

4.7.1 Biological Resources

4.7.1.1 Threatened, Endangered, and Sensitive Species

The following species are potentially present within or near OU 1093: northern goshawk, Mexican spotted owl, meadow jumping mouse, spotted bat, broad-tailed hummingbird, peregrine falcon, Wright's fishhook cactus, grama grass cactus, checker lilly, and wood lilly. The remaining species listed in Section 3.3 are dismissed from further consideration because of the lack of more specific suitable habitat components or because they have not been located on more suitable habitat in other areas of the Laboratory.

The spotted bat is found in pinon-juniper, ponderosa, mixed conifer, and riparian habitats. The two critical requirements for the spotted bat are a source of open surface water and roost sites (caves in cliffs or rock crevices). Suitable roost sites are present in portions of Pajarito and Threemile canyons. Open water sources are available and include narrow flowing streams and a large expansion of cattail and willow areas below TA-18. A survey for spotted bats was done in lower Pajarito Canyon, but none were captured (Foxx, in preparation, 16-0040). Surveys of Los Alamos Canyon in July 1992 did not result in the capture of any spotted bats. In addition, there have been no captures of spotted bats in similar surveys at TAs-8 and -36, and at Bandelier National Monument. This does not necessarily suggest that spotted bats do not exist in OU 1093; however, no adverse impact is expected to the spotted bat (if present) if potential habitat (rock faces, cliffs) and water sources within the operable unit are not disturbed or altered.

According to Terrell H. Johnson, an expert on peregrine falcons in New Mexico, the peregrine falcon has a low potential of occurrence in OU 1093 (LANL 1993, 16-0041). Although the peregrine falcon is not expected to nest in the operable unit, it may traverse the area. Sampling is not expected to impact this species.

The northern goshawk occurs in mature ponderosa pine forest. Goshawks have been found hunting within the northwest portions of Laboratory property. Nest sites are known to exist outside the borders of OU 1093 and could occur within the boundaries as well. The following measures must be taken to avoid adverse impact to goshawks:

1. Clear any machine sampling occurring between May and October through the Biological Resource Evaluation Team (BRET). Contact BRET 60 days before sampling to evaluate possible nest sites in and around the specific sampling area.

2. If any area over 0.10 acre will be disturbed, contact BRET for a presampling site-specific survey.

3. BRET must approve any tree removal (live or snag).

Habitat requirements for the Mexican spotted owl include unevenly aged, multistory, mixed conifer forests with closed canopies. Spotted owls are known to exist in Los Alamos County and may be present in mixed conifer areas in Threemile and Pajarito canyons. Contact BRET 60 days before sampling within the mixed conifer areas on the north-facing slopes of Pajarito or Threemile canyons for evaluation of specific sampling locations.

Broad-tailed hummingbirds have been reported in Bandelier National Monument, but only as migrants. These hummingbirds require riparian woodlands at low-to-moderate elevations that are characterized by cottonwood, hackberry, and oak. Riparian habitats exist within Pajarito Canyon and, to a lesser extent, in Threemile Canyon. The riparian areas of Pajarito Canyon are not characterized by cottonwood or hackberry; they have some oaks, but mostly willows. Breeding broad-tailed hummingbirds are not thought to be supported in Pajarito or Threemile canyons. There have not been any sightings of these hummingbirds on Laboratory property (Travis 1992, 0869); however, it is possible a few migrants could occur. Large disturbances of riparian areas should be avoided. If machine sampling will occur within any riparian area, contact BRET 60 days before sampling to evaluate the sampling sites.

The meadow jumping mouse has a moderate potential of being in the upper reaches of OU 1093. It lives in riparian or wetland zones along permanent water sources. If any sampling will occur along streamside areas, contact BRET 60 days before sampling to evaluate the need for a site-specific survey. A meadow jumping mouse survey can be performed only during the rainy season, optimally in July. If a survey is required, sampling cannot proceed until the survey is complete. Some surveys for small mammals occurred within OU 1093 during the summer of 1992, but no meadow jumping mice were found (Foxx, in preparation, 16-0040).

The wood lilly and checker lilly may be in OU 1093, but only in moist shaded areas in the upper portion of the canyons. If extensive sampling will occur within the upper canyon riparian areas, EM-8 will conduct a site-specific survey before sampling. These lillies have been found in Los Alamos County, but are very rare.

Wright's fishhook cactus can be found on sandy-to-gravely hills, plains, desert grasslands, or pinon-juniper woodlands. During the field season of 1992, a habitat evaluation survey was conducted for OU 1093. Vegetation data were collected throughout the pinon-juniper areas (mainly mesa tops). No fishhook cacti were found. Review of previously collected data revealed that no specimens had ever been identified in this area; however, this does not rule out the possibility of occurrence. If machine sampling is required or off-road driving is necessary in pinon-juniper habitat, notify BRET 60 days before sampling to schedule a site-specific survey for this species.

The grama grass cactus is routinely found within the sandy soils of pinon-juniper woodlands. In Los Alamos County, grama grass cactus has always been found growing within basalt outcrops. Basalt outcrops are not found within OU 1093. No grama grass cacti were found during the habitat evaluation surveys conducted during the field season of 1992. Review of previously collected data revealed that specimens have never been identified in this area. It appears unlikely that this species exists in OU 1093; however, if machine sampling is required or off-road driving is necessary in pinon-juniper habitat, contact BRET 60 days before sampling to evaluate the need for any additional surveys.

4.7.1.2 Wetlands/Flood Plains

Phase I site characterization sampling in wetlands could range from surface sampling to core drilling. Sampling within designated wetlands will be performed by qualified staff from EM-8 to minimize impacts. Potential wetland areas are indicated in Figures 3-1 and 3-2. Formal delineation of the wetland boundaries in accordance with regulatory requirements will be completed before sampling to ensure that sampling is properly conducted in those designated areas. Delineations should be done within two years before the sampling; after two years, the delineation is no longer valid and must be repeated. OU 1093 has extensive palustrine wetlands and stretches of riverine wetlands. Some delineation efforts have been undertaken in some areas of the palustrine wetlands. Notify BRET 90 days before sampling within the bottoms of Pajarito and Threemile canyons to evaluate the need for any site-specific delineations.

4.7.1.3 Recommendation

Impacts to nonsensitive species should be avoided when possible. Because off-road driving is especially harmful to plants and soil crust, vehicular travel should be restricted to existing roads whenever possible. Revegetation may be required at some sites. A list of native plants suitable for revegetation of OU 1093 will be included in the final report, Biological Assessment for Environmental Restoration Program, Operable Unit 1093 (Foxx, in preparation, 16-0040). In addition, BRET may be consulted to determine suitable species for seeding.

Additional mitigation measures include the following:

- Avoid unnecessary disturbance (i.e., parking areas, equipment storage areas, off-road travel) to surrounding vegetation during actual sampling and when traveling into the sampling sites.

- Avoid removing vegetation along water sources, including drainage systems and stream channels.

- Avoid disturbing vegetation along canyon slopes, especially drainages.

- Avoid removing trees. If tree removal is required, contact BRET for evaluation.

- In addition to the mitigation measures mentioned previously, BRET requests notification of additional disturbances before they are conducted.

The Biological Assessment for the Environmental Restoration Program, Operable Unit 1093 (Foxx, in preparation, 16-0040) will be evaluated by the US Fish and Wildlife Service for compliance with the Endangered Species Act. This federal agency may require additional mitigation measures that are not represented in this summary. Appropriate notifications of any additional required measures will be made.

4.7.2 Cultural Resources

All personnel involved in ER sampling activities must follow all monitoring and avoidance recommendations in the Cultural Resource Survey Report specific to OU 1093 (Manz and McGehee, in preparation, 16-0043). EM-8 archaeologists must be contacted 30 days before initiation of any groundbreaking activities to verify monitoring and avoidance recommendations.

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Executive Summary

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5.0 EVALUATION OF POTENTIAL RELEASE SITES

5.1 PRS Aggregate "A" for TA-18 - Liquid Waste Management Systems

Potential release sites in this aggregate consist of SWMUs identified in Table A of the HSWA Module (EPA 1990, 0306) or described in the 1990 SWMU Report (LANL 1990, 0145), and areas of concern (AOCs). All PRSs in this aggregate have been used for the management of liquid wastestreams. The specific PRSs in this aggregate are listed in Table 5-1. They include the inactive portion of a sanitary sewer line and the associated sewage lagoons; septic tanks and drain fields; sumps, settling pits, and outfalls associated with industrial waste discharge; and storm sewer outfalls. Descriptions of each of these PRSs are presented in Section 5.1.1. These PRSs were aggregated on the following basis:

- All PRSs involve liquid waste disposal or potential contamination resulting from liquids.
- The environmental transport processes responsible for any transport from the primary contaminant source are similar.

5.1.1 Description and History

Liquid waste discharged to PRSs in this aggregate consisted of sanitary sewage, wash water from industrial drains and sinks in kivas or laboratories, and photochemical wastes. Summary descriptions of these PRSs and known or suspected contaminants are listed in Table 5-1. This information was derived primarily from a review of archival information, as summarized in Chapter 2, supported by the SWMU Report (LANL 1990, 0145) and interviews with present site employees. These PRSs are described in detail in the following sections.

5.1.1.1 SWMUs 18-001(a) and (b) - Sewage Lagoons and Sanitary Waste Lines

There are two 60-ft-wide by 120-ft-long sewage lagoons with associated waste lines and an outfall into Pajarito Canyon. The lagoons and outfall are located on opposite sides of Pajarito Road, at the site of former TA-27, 0.9 miles east of TA-18, approximately halfway between TA-18 and White Rock, New Mexico (Figure 1-4). The lagoons and associated waste lines were placed in service before 1969 and remained in service through the fall of 1992. The lagoons are constructed of gunite, encircled with 6-ft-high earthen berms, enclosed by an 8-ft-high chainlink fence, and identified as TA-18-162 (recently redesignated TA-36-135). Until the fall of 1992, the lagoons served the sanitary sewer system for TA-18, excluding Kivas 1, 2, and 3 (TA-18-23, -32, and -116), which are served by individual septic systems. An estimated 12,000 ft of vitrified clay pipe connects the serviced buildings to the lagoons. The portion of the sanitary waste line between the eastern boundary of TA-18 and the lagoons became inactive with the installation of a new sewage treatment plant at TA-46 in the fall of 1992.

TABLE 5-1

PRS AGGREGATE "A"—LIQUID WASTE MANAGEMENT SYSTEMS

PRS No.	PRS Title	Structure No.	Operational Status	Period Used	Potential Contaminants
18-001(a)	Sewage lagoons	TA-36-135	Inactive	1969–1992	U, Pu, solvents
18-001(b)	Sanitary sewer line	NA	Inactive*	1969–present	U, Pu, solvents
18-001(c)	Sump	NA	Active	1969–1992	No data
18-003(a)	Settling pit	TA-18-105	Active	1946–present	U, Pu
18-003(b)	Septic tank	TA-18-39	Active	1947–present	U, Pu
18-003(c)	Septic tank	TA-18-42	Active	1952–present	U, Pu
18-003(d)	Septic tank	TA-18-120	Active	1960–present	U, Pu, oil
18-003(e)	Septic tank	TA-18-40	Inactive	1952–?	Be, U, Pu, Ag
18-003(f)	Septic tank	TA-18-41	Inactive	1952–?	Be, U, Ag
18-003(g)	Septic tank	TA-18-43	Active	1944–?	Be, U, Pu, Ag
18-003(h)	Septic tank	TA-18-152	Active	?–?	Be, U, solvents, oil
18-004(a)	Industrial drain line	NA	Inactive	1950–1977	U, solvents
18-004(b)	Collection tanks	TA-18-38	Inactive	1950–1977	U, solvents
18-012(a)	Outfall	NA	Active	?–present	Be, U, Ag
18-012(b)	Outfall	NA	Active	?–present	Be, U, solvents
18-012(c)	Sumps and drain lines	NA	Active	1966–present	Be, U, solvents

*The portion of the sanitary sewer line east of TA-18, to and including the lagoons, was taken out of service in the fall of 1992. The portion of the line interior to TA-18 is still active and discharges to a new waste treatment facility near TA-46.

According to the SWMU Report (LANL 1990, 0145), the lagoons contain sanitary sewage and, possibly, photochemical wastes. However, the only source of photochemical wastes in Buiding TA-18-30 has never discharged to the sanitary sewer line. In addition, that report incorrectly states that the sump in Building TA-18-30 [SWMU 18-001(c)] discharges to the sanitary waste line. That sump discharges to an outfall [SWMU 18-012(b)] (Section 5.1.1.4.2). However, operations in some of the buildings served by the sanitary sewer system involve hazardous and/or radioactive materials, and the historical discharge of such constituents to the sanitary sewer cannot be ruled out by any existing information. Administrative controls now in place at all Laboratory facilities provide a deterrent against such discharges in the future. At one time, the lagoons may have received liquid wastes pumped from septic tanks at other technical areas and transported by truck to the lagoons (LANL 1990, 0145). Until the fall of 1992, the lagoons discharged into Pajarito Canyon through a National Pollutant Discharge Elimination System (NPDES) outfall (Serial No. 04S). Sewage inflow to the lagoons was discontinued in the fall of 1992 with the rerouting of sewage to a new sewage treatment plant at TA-46.

The main sanitary sewer line, which collects sanitary waste from several buildings at TA-18, runs east of TA-18 along the south side of Pajarito Road (Figures 1-2 and 1-4). Sanitary sewer lines are located throughout the main complex of TA-18 and feed into the main sanitary sewer line that emptied into the lagoons. Manholes TA-18-153 to -161 and -169 to -177, numbered eastward from the west side of Building TA-18-30, are associated with the sewer line.

If sampling of the lagoons and drain lines indicates that no radioactive or hazardous contaminants are present, the lagoons and the inactive portion of the line will be decommissioned by the Laboratory. The lagoons and lines will be abandoned in place, and the manholes removed (Anderson 1992, 16-0008). If sampling indicates the presence of contamination, alternative remedial actions will be considered, as discussed in Section 4.4. Specific alternative actions would be addressed either in a plan for a VCA, or in a CMS.

The report describing the planned abandonment of the lagoons (Anderson 1992, 16-0008) indicates that the clay lines are cracked and broken in places, allowing groundwater to infiltrate the lines between the source buildings and the lagoons. In 1988, some of the lines at TA-18 were sliplined with 6-in. polyethylene pipe, greatly reducing the amount of infiltration. The amount of infiltration occurring in the inactive portion of the line is unknown at this time.

5.1.1.2 SWMUs 18-003(a-h) - Septic Systems

Individual liquid waste systems are registered under the state of New Mexico's system for tracking septic systems; no other permits are required.

Seven septic tanks (TA-18-39, -40, -41, -42, -43, -120, and -152) and one settling pit (TA-18-105) are included in this operable unit. Four of these systems are active (TA-18 -39, -42, 105, and -120), and four are inactive (TA-18-40, -41, -43, and -152) (Table 5-1). Inactive outfalls into Pajarito Canyon associated with Septic Tanks TA-18-40, -43, and -152 do not have NPDES serial numbers. An inactive outfall into Pajarito Canyon, NPDES Serial No. 104, is associated with

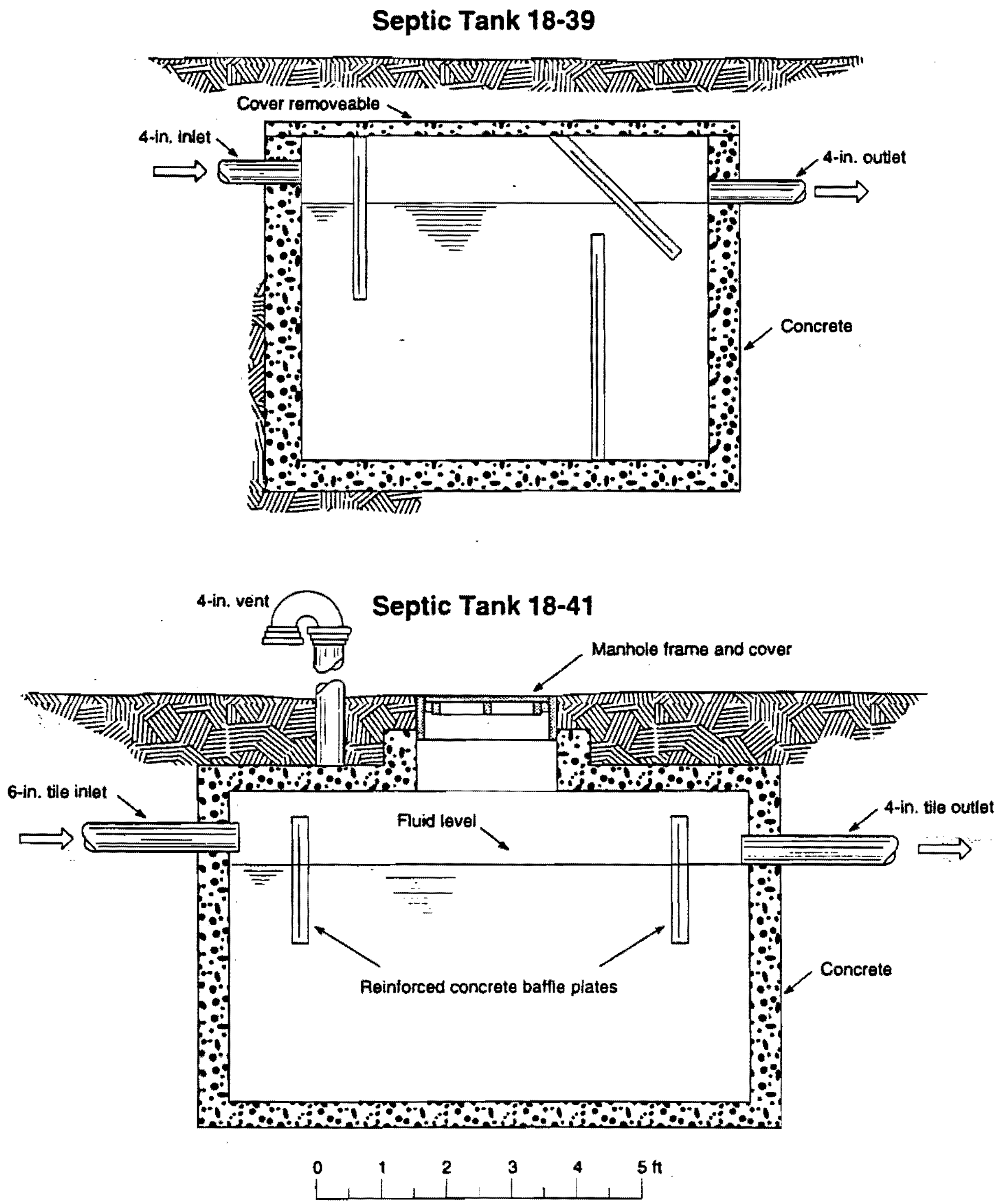
Septic Tank TA-18-41. According to the SWMU Report, Septic Tanks TA-18-40, -41, -43, and -152 were removed before March 1980; however, an onsite inspection on June 6, 1992, revealed that the tanks are still in place but are no longer in service. The manhole covers to these septic tanks were visible. Except for Septic Tank TA-18-40, which was clearly marked, the others were not marked with a structure number.

The active septic tanks, TA-18-39, -42, and -120, are unpermitted individual liquid waste systems (numbers LA-27, -28, and -29, respectively). Drain fields are associated with the three active septic tanks, with Settling Pit TA-18-105, and with two inactive septic tanks, (TA-18-40 and -41). Although the inactive systems received primarily sanitary waste, it is possible that small quantities of solvents, other chemicals, metals, and radionuclides may have been included in the waste. Known or suspected contaminants in the septic tanks and associated drain fields and/or outfalls are listed in Table 5-1.

The design of typical septic tanks at TA-18 is presented in Figure 5-1. (Design drawings for all septic tanks could not be located.) Baffles in the upper portion of the tank prevent floating material from being discharged to the drain field. The bottom portion of some tanks is compartmentalized, so solid material (typically inorganic) settling to the bottom would only be present in the inflow end of the tank. Other tanks are not compartmentalized, and solid material could be present throughout the bottom of the tank. Dissolved or suspended material is discharged from the outlet pipe, which is at a somewhat lower elevation than the inflow pipe. Discharges from the septic tank are directed to a drain field through a solid clay tile pipe. The drain fields consist of multiple parallel lines constructed from perforated clay tile pipe which either branch from a common feeder line or are all connected to a distribution box at the end of the discharge line from the septic tank. Drain fields were typically constructed by trenching the alluvium and placing individual drain field lines in the trenches, which were then backfilled with gravel or coarse rock. Available boring logs suggest that 10 to 15 ft of alluvial material is beneath each drain field. Some of the drain fields are supplied with an outfall to a surface drainage at the distal end of the drain field. In two instances [SWMUs 18-003(a) and 18-003(f)], industrial waste has been discharged to the drain field from a separate waste line that bypassed the septic tank.

5.1.1.2.1 SWMU 18-003(a) - Settling Pit TA-18-105

This settling pit serves Kiva 1 and has been in use since 1947 (Figure 5-2). It is a reinforced concrete structure that measures 5.3 ft wide by 5.3 ft long by 12 ft high, with a 2,500-gal. capacity. It has a removable steel catch basin that measures 2 ft in diameter and is 5 ft high. The basin is emptied annually by EM-Division (formerly H-Division). The acid sinks from Kiva 1 drain into the settling pit; this wash water potentially contains radionuclides. Any overflow from the catch basin would enter the Kiva 1 sanitary sewer system downstream from Septic Tank TA-18-39 [SWMU 18-003(b)] and continue to its drain field. The extent of contamination and possible mobilization is not known. A discussion of previously conducted soil and groundwater monitoring in the vicinity of this SWMU is presented in Section 5.1.2.1.2.



Source: top - ENG-C 12075
bottom - ENG-C 12718

Figure 5-1. Cross section views of Septic Tanks 18-39 and 18-41.

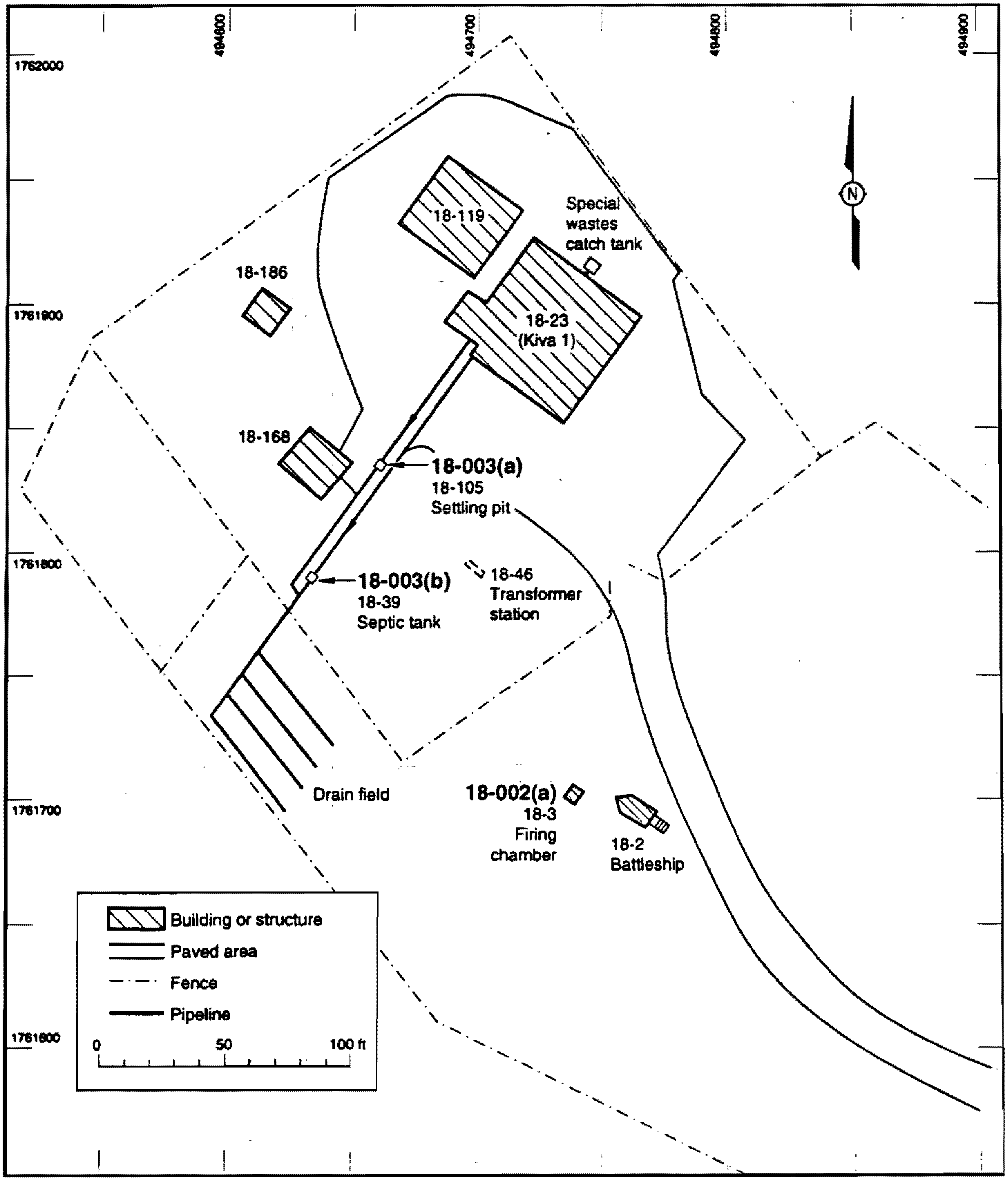


Figure 5-2. Potential release sites near Kiva 1, TA-18.

5.1.1.2.2 SWMU 18-003(b) - Septic Tank TA-18-39

This septic tank serves the sanitary sewer system of Kiva 1 and has been in use since 1947 (Figure 5-2). The septic tank is a reinforced concrete structure that measures 4 ft wide by 7 ft long by 5.5 ft high and has a 524-gal. capacity. The effluent from this septic tank empties into a drain field and, according to the SWMU Report, discharges through an outfall. Available engineering drawings did not indicate the presence of an outfall. A 1992 field inspection along an existing stream channel in Pajarito Canyon next to TA-18-39 and the drain field (the most probable location for an outfall) revealed no pipe or other structure that would represent an outfall.

5.1.1.2.3 SWMU 18-003(c) - Septic Tank TA-18-42

This septic tank serves the sanitary sewer system of Kiva 2 and has been in use since 1952 (Figure 5-3). This tank is constructed of reinforced concrete, measures 6 ft in diameter by 7 ft long, and has a 587-gal. capacity. This tank reportedly only receives sanitary waste from Kiva 2. The effluent from this septic tank discharges into a drain field that discharges through an outfall adjacent to a creek in Threemile Canyon. The extent of contamination and possible mobilization is not known.

5.1.1.2.4 SWMU 18-003(d) - Septic Tank TA-18-120

This septic tank serves the sanitary sewer system of Kiva 3 (Figure 5-4). This tank has been in use since 1960. The dimensions of this tank are not known, but the estimated capacity is 500 gal. The wastewater flows first to Septic Tank TA-18-120, then to a distribution box (TA-18-35), and then to a drain field. According to the SWMU Report (LANL 1990, 0145), it discharges through an outfall; however, during 1992 field inspections, the outfall was not located and it is not shown in building drawings. The manhole, TA-18-21, for this sanitary sewer system is located at the southwest corner of Kiva 3 and is largely obscured by pavement. A high oil content was reported in this septic tank in 1982 (DOE 1987, 0264). The extent of contamination and possible mobilization is not known, but uranium and plutonium isotopes are potential contaminants.

5.1.1.2.5 SWMU 18-003(e) - Septic Tank TA-18-40

This septic tank was put into use in 1951 and was scheduled to be taken out of service with the installation of the site's sanitary sewer system [SWMU 18-001(a) and (b)] in 1969 (LASL 1969, 16-0011). According to the SWMU Report (LANL 1990, 0145), it was removed before March 1980; however, a field inspection on June 6, 1992, revealed that this tank is still in place. The tank, which measures 6 ft in diameter by 6 ft high, is constructed of reinforced concrete, and served Buildings TA-18-31, -37, and -129 (Figure 5-5). Wastes from Septic Tanks TA-18-43 and -152 may also have discharged to this septic tank (Sections 5.1.1.2.7 and 5.1.1.2.8) (LASL 1968, 16-0017; LASL 1967, 16-0062). Sanitary waste from these buildings was rerouted to the main sewer line when it was installed in 1969 (Figure 2-10). The effluent from this tank originally

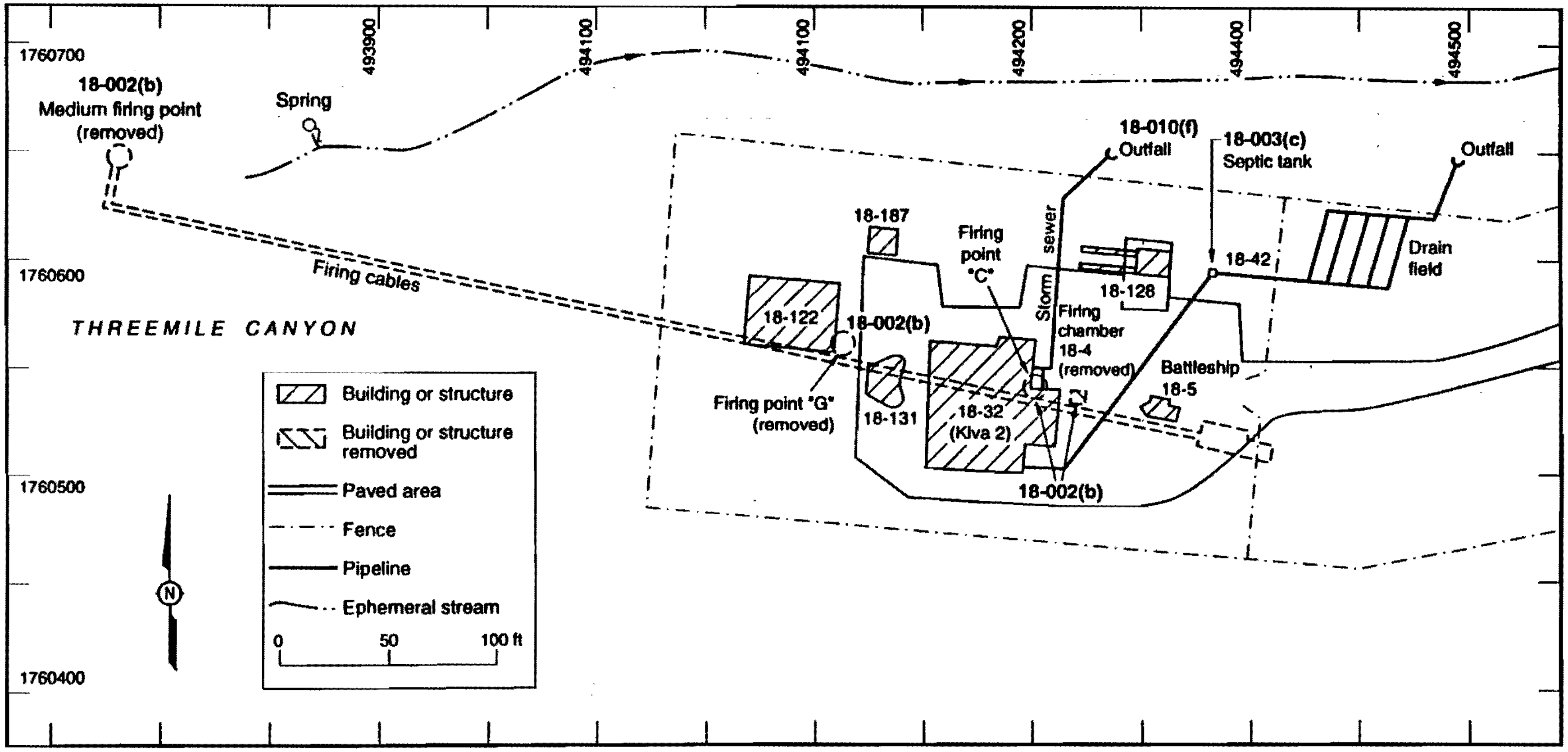


Figure 5-3. Potential release sites near Kiva 2, TA-18.

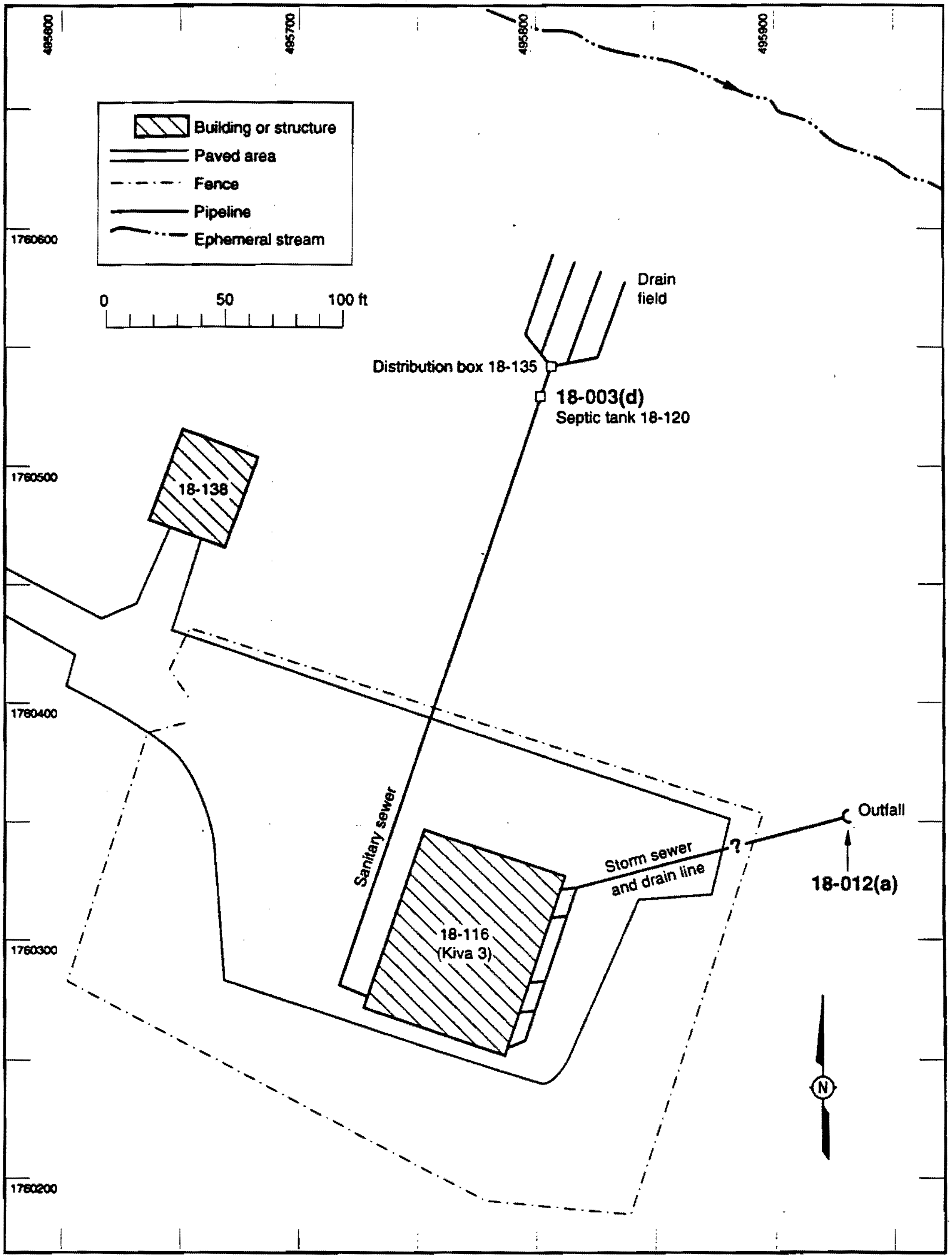


Figure 5-4. Potential release sites near Kiva 3, TA-18.

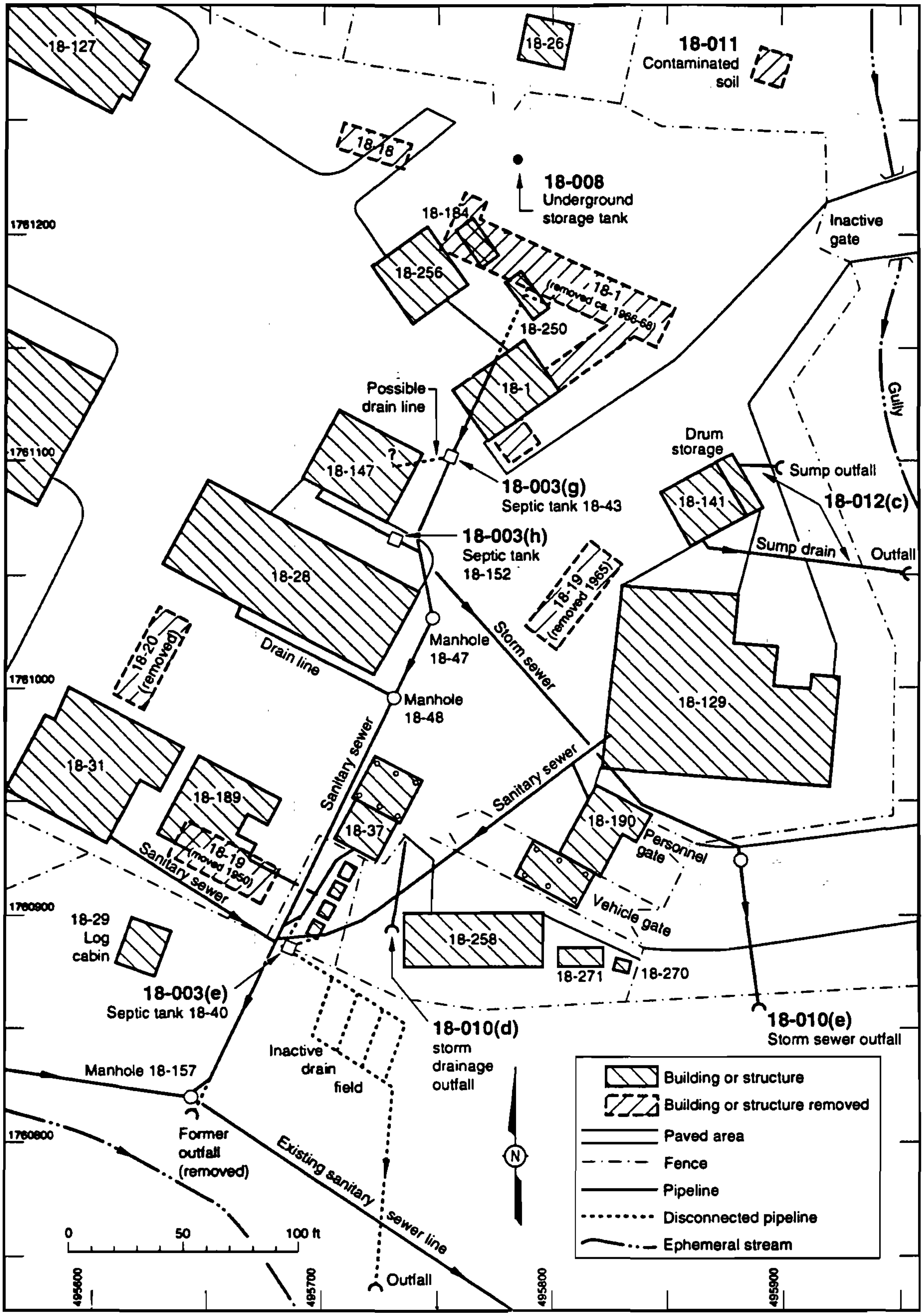


Figure 5-5. Potential release sites in central TA-18 area.

discharged into a drain field, which, in turn,discharged to an outfall (Figure 5-5). No data are available on actual radioactive or hazardous contaminants in this tank, but potential contaminants include uranium, plutonium solvents, and silver from photochemical wastes.

5.1.1.2.6 SWMU 18-003(f) - Septic Tank TA-18-41

This septic tank was put into use in 1951 and was discontinued with the installation of the site's sanitary sewer system [SWMU 18-001(a) and (b)] in 1969 (LASL 1969, 16-0011). According to the SWMU Report (LANL 1990, 0145), the tank was removed before March 1980, but a field inspection on June 6, 1992, revealed that it is still in place. Located west of Building TA-18-30 (Figure 5-6), the 1,000-gal. tank is made of reinforced concrete and received sanitary waste from Building TA-18-30. This septic tank drained west to a distribution box (TA-18-113) and its drain field, which discharged south to an outfall next to the bridge. Engineering drawings indicate that a concrete headwall was to be built at the outfall, but the headwall and outfall were not located during 1992 field inspections.

Manhole TA-18-93 is a settling pit associated with this SWMU (Figure 5-6). The settling pit received chemical waste discharge from Building TA-18-30, and any overflow from the pit discharged to the drain field downstream from Septic Tank TA-18-41. A former photochemical laboratory in Building TA-18-30 discharged through this waste line (LASL 1955, 16-0002; LASL 1955, 16-0012). After the septic tank was taken out of service, the manhole was backfilled with sand and use of the chemical waste line was discontinued (LANL 1993, 16-0010). No data are available on actual radioactive or hazardous discharges to this manhole, but potential contaminants are probably restricted to those in photochemical wastes.

5.1.1.2.7 SWMU 18-003(g) - Septic Tank TA-18-43

According to the SWMU Report (LANL 1990, 0145), this tank was removed before March 1980, but a 1992 field inspection revealed that the tank is still in place. This tank was put into use in 1944, but its discontinuation date is unknown. It served Building TA-18-1, including its photochemical laboratory (AOC C-18-001) (Figure 5-5). Radioactive materials for weapons components were sometimes placed in the original, east-west part of the building. One device, which had unsuspected oxidation on one of its components, leaked a small amount of plutonium oxide when its shipping container was opened, causing minor contamination (date uncertain). Other potential contaminants include uranium and beryllium.

The dimensions of this septic tank are 3 ft wide by 5 ft long by 5 ft high, and it is made of reinforced concrete. The tank's capacity is not known. A 1944 drawing (LASL 1952, 16-0013) of former Building TA-18-1 specifies "100 ft of 4 in. open joint tile to outlet in a gravel-filled trench," which indicates a possible associated drain field or outfall. Another drawing (LASL 1952, 16-0014) shows a line, which could represent the tile referred to in the previous drawing, heading southwest from the septic tank and extending beneath the present location of Building TA-18-147 (Figure 5-5); however, as-built drawings to verify the existence of

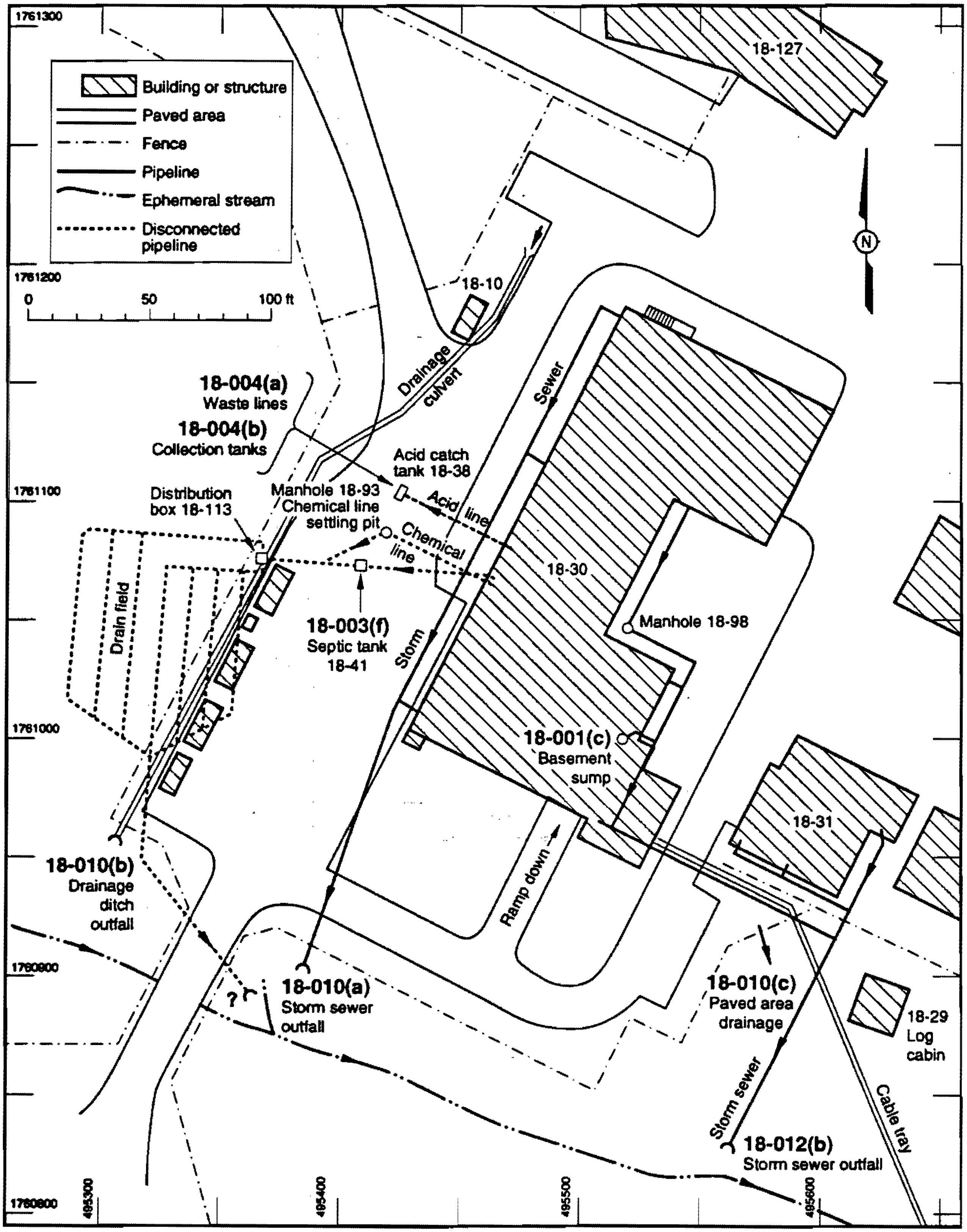


Figure 5-6. Potential release sites near Building 30, TA-18.

such a line have not been located. A 1958 drawing (LASL 1958, 16-0015) shows a line leading southward from the septic tank by way of Septic Tank TA-18-152 (LASL 1967, 16-0062) to an outfall at the creek next to the present location of Manhole TA-18-157 (Figure 5-5); however, a 1968 drawing (LASL 1968, 16-0017) shows the line connecting to Septic Tank TA-18-40. Other drawings (LASL 1968, 16-0016; LASL 1969, 16-0011) show that the line bypasses Septic Tank TA-18-40 and connects to the site's present sewer system.

5.1.1.2.8 SWMU 18-003(h) - Septic Tank TA-18-152

SWMU 18-003(h) is either an inactive settling pit or a septic tank that served Building TA-18-147, built in 1967. The dates of operation are not known. The tank is constructed of steel, measures 4.3 ft in diameter by 5 ft high, and has a capacity of 500 gal. It drained into a sanitary sewer heading south to an outfall (no longer present) at the creek next to Manhole TA-18-157 of the present sewer system (Figure 5-5). Downstream from this septic tank, sanitary waste from a sink in Building TA-18-28 entered the same line and discharged through the outfall. The line also serviced a sink in the machine shop in Building TA-18-28. It is possible that oils, solvents, and metals may have been discharged from Building TA-18-28 to this line. The line serving Buildings TA-18-147 and -28 was later connected to the site's present sewer system (Figure 2-10). (See Section 5.1.1.2.7 for a discussion of uncertainty regarding the routing of this line.) According to an engineering drawing (LASL 1969, 16-0011), this septic tank was scheduled for removal when Building TA-18-147 was connected to the site's present sewer system in mid-1969; however, site inspections in June 1992 suggest the tank is still in place.

5.1.1.3 SWMUs 18-004(a) and 18-004 (b) - Drain Line and Tanks

SWMU 18-004(b) was a subsurface concrete containment pit, TA-18-38, measuring 4 ft wide by 9 ft long by 8 ft high. This pit contained two stainless steel tanks that were designed to receive radioactively contaminated liquid waste from Building TA-18-30. A sump measuring 9 in. wide by 9 in. long by 6 in. high was built into the floor of the pit (possibly to catch any overflow from the tanks). The containment pit was on the west side of Building TA-18-30 (Figure 5-6). When the tanks became full, they were removed for waste disposal, cleaned, and returned. These tanks were used from the 1950s until 1977, when they were decommissioned. The tanks were removed, the inflow line was capped, the concrete pad was left in place, the walls of the pit were razed, and the area was backfilled to grade.

Interviews with former site personnel (Mynard 1992,16-0030; Mynard 1992, 16-0065) indicate that radioactive sources, detectors, and reactor fuel elements were the only radioactive materials present in Building TA-18-30, and that no radioactive liquids were ever present. Further, an individual who worked in the room served by the drain line [18-004(a)] stated that no radioactive waste was discharged to the tanks, but that some chemical waste (primarily acids) was discharged (Hesch 1992, 16-0010).

A 3-in. stainless steel industrial drain line [SWMU 18-004(a)] connected the sinks on the west side of Building TA-18-30 to these tanks (LASL 1953, 16-0018). Since no information on the removal of this line was found, it is assumed that the entire drain line from Building TA-18-30 to the pit location line remains buried in place.

5.1.1.4 PRSs 18-001(c) and 18-012 (a-d) - Sumps, Drain Lines, and Outfalls

Five PRSs share common characteristics through their being systems for the collection and discharge of liquids that may include industrial wastes. The systems include sumps, drain lines, and/or outfalls.

A typical sump is a tank containing an arrangement of baffles or other flow disrupters to allow particulates to settle from the flowing water. Sealants are used in the construction of the tank to prevent leaking. The outflow line is near the top of the tank so that only the decant from the waste discharged to the sump outflows from the sump. Industrial drain lines are typically 4-in. lines that allow wastewater to flow from a drain (usually a floor drain or an industrial sink) to a catch tank, an outfall, or another discharge point. Outfalls are the discharge points at the ends of drain lines that allow liquids to empty into a streambed or sand pit.

5.1.1.4.1 SWMU 18-012(a) - Outfall

A combined industrial drain and storm sewer serves Kiva 3. These lines drain the roof, floor drains, and sinks of Kiva 3 (Figure 5-4). According to as-built drawings (LASL 1968, 16-0019), the drain discharges to an outfall north of the northeast corner of Kiva 3, but 1992 field inspections did not locate the outfall. However, an unlabeled 4-in. polyethylene pipe extends northeastward from the fill at the northeast corner of Kiva 3's security fence and drains onto the ground (Figure 5-4). A dye-trace test revealed that this pipe is the outfall [SWMU 18-012(a)] for this system (Santa Fe Engineering 1992, 16-0067).

5.1.1.4.2 SWMUs18-001(c) and 18-012(b) - Sump and Outfall

A single sump equipped with two sump pumps is located in the basement of Building TA-18-30 (Figure 5-6). This sump, SWMU 18-001(c), was erroneously reported in the SWMU Report (LANL 1990, 0145) as discharging to the sanitary sewer line. Under the discussion of SWMU 18-012(b), that same report incorrectly identified as two sumps, the two sump pumps in the basement of Building TA-18-30. Liquids from basement floor and sink drains and first floor sink drains are evacuated from the sump and discharged to an outfall [SWMU 18-012(b)] (Figure 5-6) (LASL 1955, 16-0002). Storm water from the roofs of Buildings TA-18-30 and -31; floor drains, sinks, and a welding quench tank from a machine shop in Building TA-18-30; and floor drains from Building TA-18-31 bypass the sump but discharge to the outfall. No specific data are available on the nature of waste discharges through these lines. A release of approximately 50 mCi of polonium-210 occurred on February 4, 1955, in the portion of the building served by this sump. With a half-life of 140 days, the polonium has decayed to approximately 5 x 10^{-32} of the original release (Section 4.3.2.1) and will be currently undetectable. Suspected contaminants listed in Table 5-1 were identified on the basis of probable operations in the buildings served by this discharge line.

5.1.1.4.3 AOC 18-012(c) - Sump and Two Drain Lines

According to the SWMU Report (LANL 1990, 0145), a sump and two drain lines of unknown origin are located northeast of Building TA-18-141. A field inspection revealed two metal posts, each labeled drain, east of Building TA-18-141. An engineering drawing (LASL 1965, 16-0020) shows a pit in Building TA-18-141 with an associated 4-in. cast-iron drain line leading out of the building. The pit houses an ultrasonic cleaner containing ethanol and benzene that is used for cleaning beryllium parts and possibly radioactive items. In the event of a spill from the ultrasonic cleaner, the sump would discharge only to the outfall, which empties into a drainage ditch east of Building TA-18-141 (Figure 5-5). The same drawing shows another drain line (3-in. cast iron) exiting the building and leading in an easterly direction. The 3-in. drain line is connected to floor drains and sinks in the building. The outfall for the 3-in. drain line is a dry well sump outside the building that is approximately 20 ft upstream from the location shown in the drawing. A 1992 field inspection verified the presence of this sump.

5.1.1.4.4 Special Wastes Catch Tank - Kiva 1

A review of engineering drawings (LASL 1946, 16-0021; LASL 1946, 16-0022) revealed a catch tank for "special wastes (extra-valuable materials)" outside the north side of Kiva 1 (Figure 5-2). The drawings showed the presence of an open-bottomed concrete pit below grade equipped with a stainless steel catch tank supplied by a pipe from inside the building. A 1992 site inspection did not reveal any surface expression of the pit outside the building, but a capped drain pipe was inside the building at the point indicated in the drawing. Discussions with site personnel could not establish what the drain pipe and catch tank may have been used for, or if they were ever used at all. Because this catch tank has not been previously identified as a PRS, it has no numerical designation. In lieu of any evidence confirming its existence, it is being treated only as a possible release site in this investigation and will not be proposed for formal designation until field investigations have been completed.

5.1.2 Conceptual Exposure Model

Phase I sampling will be aimed at establishing the concentration of radioactive or hazardous constituents in soils within the PRSs for comparison with screening action levels (Section 4.2.2). Use of screening action levels assumes that exposure occurs at the present location of soil contamination. Figure 4-3 illustrates potential release and transport processes associated with the PRSs in this aggregate.

Conceptual exposure models for potential site receptors are discussed in Section 4.2. These exposure models will not be used in the analysis of Phase I data for the liquid waste management systems, but will be considered in the design of any required Phase II sampling, or in proposals for a VCA.

5.1.2.1 Existing Information on Nature and Extent of Contamination

Only limited environmental sampling has been previously conducted within OU 1093. Sampling of the sewage lagoons and associated outfall [SWMU 18-001(a)] was conducted as part of the NPDES permit compliance program, and groundwater monitoring wells were installed in the vicinity of Septic Tank TA-18-39 [SWMU 18-003(b)].

5.1.2.1.1 SWMU 18-001(a) - Sewage Lagoons

On April 13 and 14, 1988, the lagoons were sampled and analyzed for VOCs and SVOCs. The EPA-approved methods used at the time were contract laboratory procedures-VOCs and contract laboratory procedures-SVOCs, respectively. Quality assurance laboratory samples were also taken for control purposes. Twelve lagoon samples of each category were taken and only the liquid was sampled, not the sludge. The results of the analysis indicate that all constituents were below detection limits (30 ppb for VOCs and 20 ppb for SVOCs) (Sutcliffe 1988, 16-0031); however, many of these potential contaminants have screening action levels substantially below 20 ppb (Section 4.6).

5.1.2.1.2 SWMUs 18-003(a) and (b) - Septic Systems and AOC 18-006

Data on potential environmental contamination for SWMUs 18-003(a) and (b), and AOC 18-006 were obtained from an environmental investigation performed in 1990 in support of a safety analysis report (LATA 1991, 16-0005) for the Los Alamos Critical Experiment Facility (LACEF) (TA-18-168) adjacent to these PRSs. The LACEF is an experimental facility for the investigation of criticality reactions in uranium solutions. The objective of the investigation was to define baseline levels of uranium and/or fission product contamination in the soil and groundwater near the facility. It was recognized that previous operations at TA-18, or elsewhere in Pajarito Canyon, may have resulted in surface or subsurface contamination in the vicinity of the LACEF.

During the investigation, four shallow monitoring wells were drilled in the alluvium near Building TA-18-168 (Figure 5-7). Well MW-1 is upgradient from the building, and the remaining three are downgradient. All wells are downgradient from the drain field serving Septic Tank TA-18-39, but were not located with the intent of providing any data on soil or groundwater contamination from the SWMUs in the area. During well construction, soil samples were collected with a split-spoon sampler at depths of 10, 15, and 20 ft. One borehole (identified as AH in Figure 5-7) inadvertently penetrated the drain line extending southwest from SWMU 18-003(a) (TA-18-105), which intersects the outflow line from SWMU 18-003(b) (TA-18-39) before the drain field. A soil sample was taken from directly beneath the drain line, and the hole was abandoned. A soil sample was also collected near Otowi Bridge on the Rio Grande, 10 miles east of Los Alamos, at

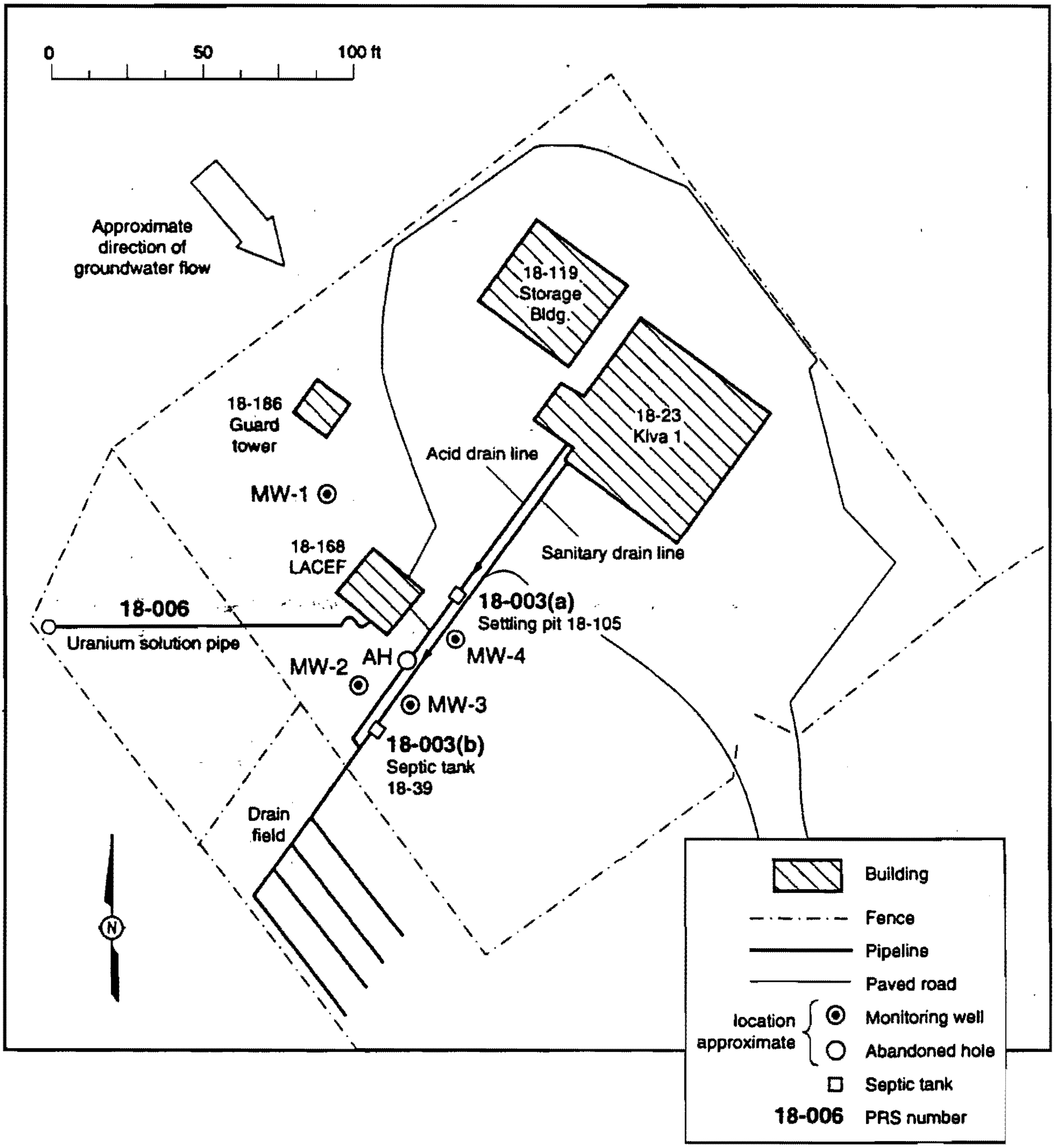


Figure 5-7. Location of shallow monitoring wells near the LACEF (18-168).

the location chosen for perimeter soil sampling by the Laboratory (Environmental Protection Group 1992, 0740). All soil samples were analyzed for a suite of radionuclides that could potentially be released from the adjacent LACEF facility. Water samples from the completed wells were also analyzed for radionuclides. Results of these analyses are presented in Tables 5-2 and 5-3 for the soil and water samples, respectively.

With one exception, the data indicate that no significant differences in radionuclide concentrations in soil exist between the downgradient locations and the upgradient or offsite background sampling locations. The soil sample from beneath the drain line contained concentrations of uranium-234 and -238 discernibly above background levels. (Screening action levels for radioactive constituents have not been established, but the measured values are well below screening action levels currently under discussion.) All measured radionuclide concentrations in the groundwater samples were less than detection limits and, therefore, differences between up- and downgradient wells could not be detected. However, the stated detection limit for uranium was significantly less than a proposed maximum concentration level of 30 pci/L for uranium in public drinking water supplies (EPA 1991, 0887). No data are known to exist on the extent of contamina-tion associated with the other septic system SWMUs.

5.1.2.2 Potential Pathways for Contaminant Migration

Release and transport processes applicable to PRSs in OU 1093 are illustrated in Figure 4-3. For liquid waste management systems, the primary mechanisms for release to the environment are system leaks and the discharges associated with drain fields and outfalls. The releases could contaminate subsurface soil (with subsequent potential groundwater contamination) or stream channel sediments or, if systems are in the saturated zone, could affect groundwater directly. Subsequent transport by streamflow or groundwater flow could result in contamination of channel sediments or groundwater at some distance from the primary source. The transport processes of percolation, groundwater flow, and streamflow are discussed in Sections 4.3.2.4, 4.3.2.5, and 4.3.2.2, respectively. Upward transport by soil moisture of potential contaminants to the soil surface is unlikely because of the relatively permeable nature of the surrounding alluvial material. VOC volatilization is possible.

5.1.3 Remediation Alternatives and Evaluation Criteria

The areas around these liquid waste management systems could be excavated to remove contamination (if any exists), and the excavated soils and structures disposed of appropriately. A description of potential response actions and associated data needs are presented in Section 4.4. Phase I data will be collected to establish which contaminants are present and their concentrations inside the septic tanks, manholes, drain lines, and sewer lines; within lagoons and drain fields; and at outfalls. These data will be used to evaluate the need for a response action and to establish constraints on the response action (such as specifying any treatment that may be required before waste disposal). If no contamination is found above screening action levels for structures, soils, or groundwater, no further action (NFA) will be proposed for these SWMUs. If the

TABLE 5-2

RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES FROM SHALLOW MONITORING WELLS (pCi/g)

		ELEMENT				
Well number	**Well depth (ft)**	^{137}Cs[a]	^{90}Cs[b]	^{234}U[c]	^{235}U[c]	^{238}U[c]
MW-1	10.0 – 11.25	<0.05	0.35 ± 0.09	0.10 ± 0.03	<0.05	0.10 ± 0.02
	15.0 – 16.75	<0.03	0.17 ± 0.07	0.10 ± 0.03	<0.05	0.08 ± 0.03
	25.0 – 27.0	<0.03	0.16 ± 0.08	0.10 ± 0.03	<0.05	0.07 ± 0.02
MW-2	10.0 – 11.5	<0.06	0.13 ± 0.06	0.13 ± 0.03	<0.05	0.14 ± 0.03
	15.0 – 16.25	<0.05	<0.05	0.10 ± 0.03	<0.05	0.10 ± 0.02
	15.0 – 16.25	<0.02	<0.05	0.16 ± 0.03	<0.05	0.14 ± 0.03
	20.0 – 21.5	<0.04	<0.05	0.12 ± 0.03	<0.05	0.11 ± 0.02
MW-3	10.0 – 11.25	<0.04	0.15 ± 0.08	<0.05	<0.05	<0.05
	15.0 – 16.25	<0.03	0.48 ± 0.09	0.14 ± 0.05	<0.05	0.11 ± 0.06
	20.0 – 21.50	<0.02	0.27 ± 0.09	0.11 ± 0.03	<0.05	0.13 ± 0.03
	20.0 – 21.50	<0.03	0.12 ± 0.07	0.12 ± 0.03	<0.05	0.09 ± 0.02
MW-4	10.0 – 11.25	<0.04	0.13 ± 0.06	0.17 ± 0.03	<0.05	0.16 ± 0.03
	15.0 – 16.50	<0.03	0.25 ± 0.07	0.10 ± 0.02	<0.05	0.07 ± 0.02
	20.0 – 21.50	<0.03	0.22 ± 0.08	0.15 ± 0.03	<0.05	0.15 ± 0.03
AH[d]	5.0 – 6.5	<0.03	0.14 ± 0.12	3.11 ± 0.15	0.10 ± 0.03	1.56 ± 0.11
Background[e]		0.04 ± 0.03	0.21 ± 0.08	0.09 ± 0.03	<0.05	0.0 ± 0.03

a. Equipment used on these samples had a nominal detection limit of 0.1 pCi/g but the Laboratory was able to obtain enhanced detection due to lack of interference.
b. Equipment used on these samples had a minimum detection limit of 0.03 pCi/g.
c. Equipment used on these samples had a minimum detection limit of 0.05 pCi/g.
d. An abandoned hole (AH) was also sampled.
e. Sample was collected at the Otowi Bridge area.

TABLE 5-3

RADIONUCLIDE CONCENTRATIONS IN WATER SAMPLES

Element	Concentration (PcI/L)
Cesium-137	<5.0
Strontium-90	<0.5
Tritium	<500
Uranium-234	<0.6
Uranium-235	<0.6
Uranium-238	<0.6

concentrations are above screening action levels, a Phase II investigation may be necessary (if Phase I data are insufficient), leading to a baseline risk assessment. The following sections identify potential response actions appropriate to the PRSs in this aggregate.

5.1.3.1 Voluntary Corrective Actions

VCAs are described in detail in Section 4.2.3. Septic systems in OU 1093 are both active and inactive. For the inactive septic systems, SWMUs 18-003(e), (f), (g), and (h), the ER Program proposes to sample within the tanks and drain field and to carry out tank, line, and soil removal as VCAs, if contamination is found. These VCAs would be performed subsequent to Phase I investigations. For some PRSs where contamination is detected in Phase I sampling, some or all of the excavation may be deferred until site decommissioning, provided current risks are acceptable, because removal could cause site disruption. The basis for such decisions is addressed in Section 4.2.3.1. For example, in SWMU 18-003(f), the effluent line from the septic tank to the drain field, and a portion of the drain field, underlie a security fence. Removal of the line during the remedial investigation could require temporary relocation of the security boundary, which would require review and approval by site and security personnel. A decision could be made to defer such removal until a later time, if there are no current health risks associated with the line. Such a decision could involve a Phase II investigation of the perched groundwater body, as described in Section 4.5.1.8.

5.1.3.2 Deferred Action for Active Systems

The active septic tanks, SWMUs 18-003 (b), (c), and (d), and the settling pit, 18-003(a), will be deactivated after the sewer systems from the three kivas are connected to the new sewage treatment plant at TA-46, and an alternative waste-collection system will be developed to replace the settling pit. The two septic tanks, 18-003(g) and (h), are active, but only in the sense that wastes pass through them to the central sanitary waste line. At present, there is no schedule for deactivation of the active SWMUs. VCAs will be implemented for any of the systems shown to contain radioactive or hazardous contamination after they are deactivated; however, full characterization of these active systems will not be performed during Phase I because of a potential for contamination before their eventual deactivation. Phase I investigations for the active systems will characterize the in current risk (Section 4.3.2.2). If this assessment indicates that current risks are unacceptable, the possibility of performing a VCA will be evaluated for inclusion in the Phase I report.

5.1.4 Data Needs and Data Quality Objectives

The overall decision strategy for RFI investigations is addressed in Section 4.2 of this work plan. As discussed in Sections 5.1.1 and 5.1.2, only very limited data are available on the identity or concentrations of hazardous or radioactive constituents at the potential release sites in this aggregate. These data are not sufficient to assess whether contaminants are present or whether the current risk from the sites is above acceptable levels; therefore, Phase I investigations will focus on a screening assessment of these release sites. The primary objective of Phase I investigations is to measure the present concentrations of potential contaminants in structures and environmental media. The specific media of concern will be the soils, sediments, and shallow groundwater at the site, consistent with the pathways model discussed in Section 5.1.2.2. The comparison of these measured data with screening action levels, as detailed in Section 4.1.4 of the IWP (LANL 1992, 0768), will lead to a decision regarding the need for corrective action at the respective release sites.

Specific quality objectives with regard to precision, completeness, and comparability are addressed in the generic Quality Assurance Project Plan (QAPjP) (LANL 1991, 0553) and are incorporated by reference in the operable unit QAPjP (Annex II of this work plan). Quality objectives for accuracy and representativeness are addressed in Sections 5.1.4.1 and 5.1.4.2.

The use of screening action levels as decision criteria for proposing NFA assumes that exposure occurs at the present location of the potential contaminants. Thus, in general, no data are required from Phase I to evaluate potential migration pathways or to define potential receptors. These considerations will be included in the design of any required Phase II investigations. Data regarding potential contamination of the underlying shallow groundwater will be collected in Phase I for all septic systems. These data, when combined with data from existing monitoring wells in the shallow groundwater (Section 5.6), will be used to assess the current risk associated with these active septic systems.

It is possible that potential contaminants released to liquid waste systems may not be present above screening action levels (for groundwater) in the immediate vicinity of source areas, but may be at higher concentrations downgradient from the source areas. Existing data on the shallow groundwater in Pajarito Canyon indicate that this is unlikely; however, for completeness, Phase I investigations will include a groundwater sampling component, as addressed in Section 5.6.

5.1.4.1 Source Characterization

Phase I data will be collected to establish the concentrations of potential contaminants of concern in structures and environmental media potentially affected by each PRS, derived from the list of suspected contaminants in Table 5-1. Very little information exists on actual waste discharges to these PRSs. Thus, the potential contaminants of concern have been identified based on known operations in each of the buildings served by the respective PRSs and the types of materials used in these operations. As previously stated, the measured concentrations will be compared with screening action levels to establish the need for further investigation or to propose NFA. Thus, the sample collection and analysis must result in contaminant detection limits that are at or below the screening action levels. Analytical methods to accomplish this are presented in the generic QAPjP (LANL 1991, 0553), as incorporated in Annex II, Quality Assurance Project Plan.

The collected data must be representative of the sampled region. The area potentially affected by each PRS in this aggregate is relatively small, and therefore, the consequences of overlooking a fraction of each site that is actually contaminated is relatively small. A statistically based sampling strategy will be used, as described in Section 4.5.1.3, to determine the number of sampling locations selected for each PRS. Specifically, sampling will be designed to detect contamination affecting at least half the area potentially affected by each PRS, with a probability of 95%. For most PRSs, the sampling is further biased within the sampled region to select locations where contamination is more probable. This will increase the probability of detecting contamination, but by an indeterminate amount. If Phase II investigations are required, the statistical variability observed in Phase I sampling will be used to design the sampling plan. Sampling will be designed to this standard, as discussed in the following sampling plans. Quality control samples (splits, duplicates, equipment blanks, and transportation blanks) will also be collected, as discussed in Annex II, Quality Assurance Project Plan.

Specific data needs include the concentrations of potential contaminants inside the septic tanks, manholes, drain lines, sewer lines, lagoons, drain fields, outfalls and/or tuff adjacent to them, in channel sediments below the outfalls, and in shallow groundwater. Contaminant concentrations in the liquid waste management systems will be compared with screening action levels and, if they are above those levels, with requirements for disposal. Contaminant concentrations in soil, tuff, sediment samples, and groundwater around these liquid waste management systems will be compared with screening action levels for soil. Phase I investigations in this aggregate will include groundwater; Phase II investigations will obtain data on the concentrations of the contaminants of concern in the shallow groundwater.

5.1.4.2 Data for Evaluation of Environmental Setting

Phase I investigations will be focused primarily on source characterization, and data on potential contaminant transport from those source areas will only be collected during possible Phase II investigations at PRSs. Some groundwater sampling will be performed as part of Phase I investigations and will provide limited additional data on the configuration of the shallow groundwater body to augment data from existing monitoring wells (Section 5.6).

5.1.4.3 Potential Receptors

All Phase I sampling is designed for comparison of constituent concentrations with screening action levels, or for characterization of potential source areas for active septic systems. Risks to current site workers from active septic systems will be evaluated through comparison of surface soil concentrations with screening action levels or a baseline risk assessment, as necessary. The potential for contaminant transport in groundwater will also be investigated at the active sites. However, no additional data on current receptors are required. Phase II investigations, if required, will consider future and existing site receptors, as described in Section 4.3.

5.1.5 Sampling Plans

5.1.5.1 SWMUs 18-001(a) and (b) - Sewage Lagoons and Sanitary Waste Lines

Previous analyses of the liquid from the lagoons did not indicate the presence of VOCs or SVOCs (Section 5.1.2.1.1); however, the liquid was not analyzed for other potential contaminants of concern, and no analyses of sludge in the ponds were performed. It is the intent of the Laboratory to decommission the inactive portion of the sanitary waste line and the lagoons, whether or not contamination is present. The inactive portion of the sanitary waste line is east of the eastern boundary of TA-18, beginning at Manhole TA-18-159 near the newly completed pumping station, and extending to the lagoons (Figure 5-8). The manholes would be removed and the remaining holes backfilled. The clay tile lines would be abandoned in place. The sludge and liquid would be removed from the lagoons and disposed of appropriately; the gunite lining would be broken up and removed; and the open excavation would be backfilled to grade. If contamination is detected in part or all of the inactive portion of the system, this activity would be proposed as a VCA and would be accompanied by appropriate sampling. Full characterization of the soil surrounding the system is best accomplished in association with excavation of the manholes and lagoons, rather than as a separate sampling activity. Thus, phased investigation of the inactive portion of this PRS will occur as follows:

- Phase I - Sample interior of manholes, liquid and sludges in lagoons, and outfall. Sample shallow groundwater near the waste line. Determine disposal requirements for liquid, sludges, and debris from decommissioning of manholes and lagoons. Propose Phase II sampling plan for the inactive and/or active portion of the sanitary system based on the results of Phase I.

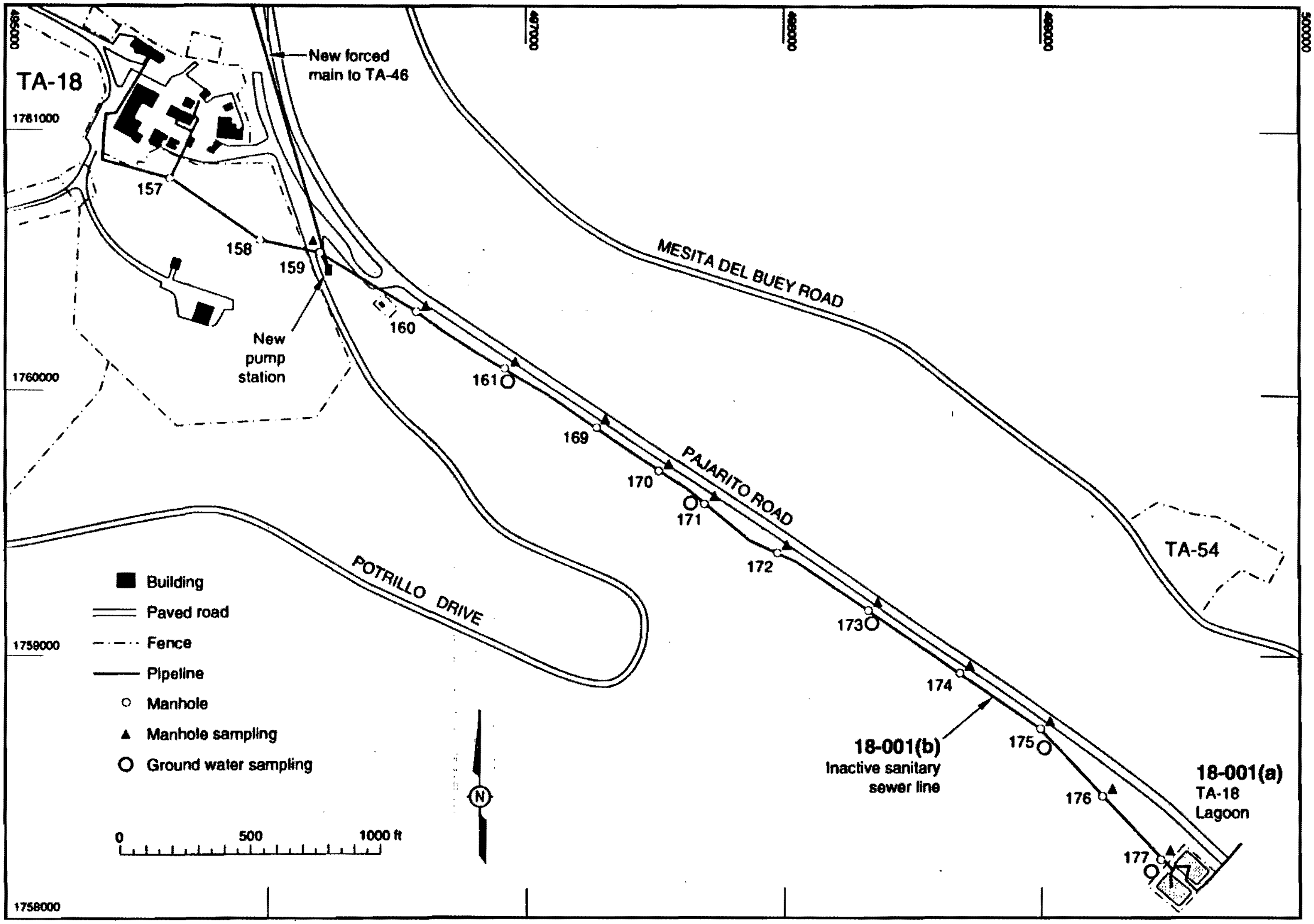


Figure 5-8. Proposed sampling locations along sanitary sewer line from TA-18.

- Phase II - Remove lagoon liners and manholes. Sample surrounding and underlying soil. Conduct additional groundwater sampling as appropriate, based on Phase I results. Develop recommendations for further remediation (VCA or CMS) or NFA.

Details of the proposed sampling are presented in Table 5-4, as supported by the sampling strategies described below. Proposed sampling locations along the inactive line are shown in Figure 5-8, and those near the lagoons are shown in Figure 5-9. All collected samples will be properly containerized and submitted for the analyses specified in Table 5-4. Quality assurance samples, as detailed in Table 5-4, will be collected in excess of the minimum standards established in the generic QAPjP, as incorporated in Annex II, Quality Assurance Project Plan.

5.1.5.1.1 Phase I Sampling of Sewer Line

Locations of the manholes are readily identified by inspection, and no engineering surveys will be required. Sampling will begin at the manhole closest to the lagoons, and proceed upgradient. The objective of the sampling and measurements is to determine if the interior of any manholes is contaminated. Such contamination would need to be accounted for in the disposal of the manholes and would be indicative of potential contamination of the shallow groundwater. Field screening of the interior space of each manhole for radioactivity (Procedures C-3 and C-4, Appendix C), VOCs (using Procedure C-5, Appendix C), and combustible gases will be done before any sampling is performed (Annex III). All manholes are constructed such that the bottom of the manhole is level with the invert elevation of the pipes entering and exiting the manhole; therefore, little or no space is available in which sludge or sediment may have accumulated. Each manhole will be entered using proper procedures for confined space operations (Annex III), and the sides and bottom of the manhole will be monitored for radioactive surface contamination using Procedure C-1, Appendix C. If any accumulated sediment is observed, samples will be collected using a spade and scoop (SOP-06.09).

As indicated in Section 5.1.1.1, groundwater has previously infiltrated the clay tile lines and/or manholes. This suggests that, at least seasonally, wastewater may have exfiltrated the clay lines, and potentially contaminated groundwater. Because of historical changes in operations at TA-18, contamination could have entered the groundwater in the past, and not necessarily be detectable in the manholes. There are no data on the potential interactions between groundwater and liquid waste flows in the sanitary line.

The objective of the groundwater sampling is to obtain sufficient data to determine, with a 95% probability, if potential contaminants of concern are present in the groundwater over at least 50% of the line. This can be accomplished with five sampling locations distributed over the length of the line (Section 4.5.1.3). The flow of shallow groundwater is assumed to be subparallel to the sewer line, and the effects of any past releases to the groundwater would be integrated over the length of the line. For initial sampling, the line will be divided into five segments, with samples collected from each segment. If

TABLE 5-4

SAMPLING PLAN FOR SWMU 18-001, SANITARY SEWER LINE AND LAGOONS

			Field Survey					Analytical Laboratory											
PRS Number	**PRS Description**	**Sample Description**	Location survey	Geophysical survey	Rad screening (α, β, γ)	TPH field test	VOC screening	No. of sampling locations	Mob. lab. rad. screening (α, β, γ)	VOCs (TCLP/EPA 8240)	SVOCs (TCLP/EPA 8270)	Metals (TCLP/EPA 6010)	HE (USATHMA[a])	General mineral (std. methods)	Uranium (total) (DOE[d])	Plutonium (isotopic) (DOE[d])	Thorium (isotopic) (DOE[d])	Gamma spectroscopy (DOE[d])	TPH (EPA 418.1)
18-001(b)	Sanitary sewer line																		
	Manholes (11)				X		X												
		Sludge (if present)						11[c]	X	X	X	X			X	X		e	
		Groundwater						5	X	X	X	X		X	X	X		e	
		Wipes						40[b]	X			X			X	X		e	
	QC samples																		
		Wipes——duplicates						4	X			X							
		Groundwater—duplicates						1	X	X	X	X		X	X	X		e	
		Sludge—duplicates						1	X	X	X	X			X	X		e	
		Rinsate blanks						2[c]	X	X	X	X		X	X	X		e	
		Field blank (water)						1	X	X	X	X		X	X	X		e	
18-001(a)	Lagoons (2)	Liquid			X			6	X	X	X	X			X	X		e	
		Sludge			X		X	10	X	X	X	X			X	X		e	

a. US Army Toxic and Hazardous Materials Agency, no date, 0522.
b. Assumes four wipes per manhole.
c. Maximum number, assuming all manholes contain sludge.
d. HASL-300 (DOE 1983, 0516).
e. Only when gross-gamma is above background.

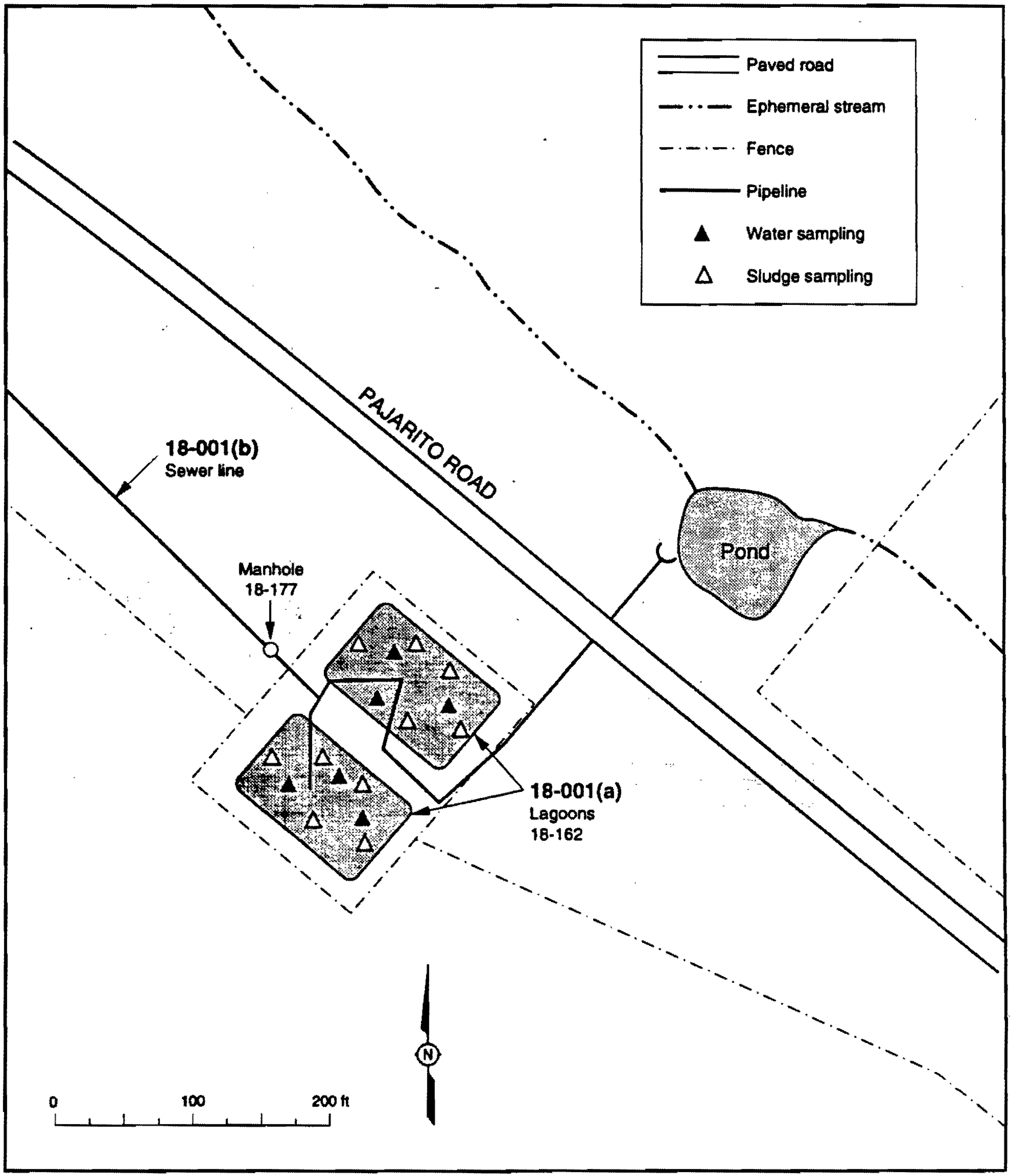


Figure 5-9. Proposed sampling locations at SWMU 18-001(a), sewage lagoons.

contamination above screening action levels is detected, additional samples will be collected as part of a Phase II investigation.

Even though use of the sewer line has been discontinued, some water could be flowing through the line. The water table in that portion of the canyon is relatively shallow and water is known to have infiltrated this line in the past (Section 5.1.1.1). The water table can thus be expected to be (at least seasonally or in some locations) above the depth at which the lines are buried. The groundwater along the length of the line can therefore be sampled in one of two ways: direct sampling of groundwater near the line using monitoring wells or a hydropunch, or collection of groundwater that has infiltrated the line.

If any water is flowing through the manhole, samples will be collected for analysis. Water flowing through a particular manhole can be considered to represent some mixture of all groundwater flowing into the line upstream from that manhole. An estimate will be made of the volumetric flow rate of the water by measuring the cross section of flow and the linear flow rate of the water. Linear flow rate can be estimated by measuring the time required for floating material (such as a cork) to traverse a measured distance. These volumetric flow rate values will be used to construct a water balance of the influx and efflux of water to the line throughout its length. This will allow, to some degree, a determination of the probable source areas for each sample.

If no water is observed flowing in a particular segment of the line, groundwater will be sampled directly using a hollow-stem auger and a hydropunch (Procedure C-8, Appendix C). The sampling location will be at the downstream end of the respective segment. Samples will be collected from approximately 2 ft below the water table, if the water table is below the elevation of the sewer line; otherwise, a water sample will be collected from just below the elevation of the line.

5.1.5.1.2 Phase I Sampling of Lagoons

The objective of the sampling is to determine, with a 95% probability, if potential contaminants of concern are in the water or sludges in the lagoons above media-specific screening action levels in at least 50% of each lagoon. This can be accomplished with five sampling locations in each lagoon. If potential contaminants of concern are present, the liquid and/or sludge may need to be dealt with as hazardous, radioactive, or mixed waste. If potential contaminants of concern are not present, these materials could be disposed of as noncontaminated waste.

Because the lagoons are now inactive, liquid is present in the lagoons only as a result of precipitation, perhaps augmented by some groundwater infiltration of the sewage line (See Section 5.1.5.1.1). Increased evaporation in summer months, coupled with reduced inflow, could result in evaporation of most or all of the liquid now in the lagoons. It will assumed that do to natural mixing, concentrations of potential contaminants will be relatively uniform in any liquid in the lagoons. Three samples will be collected of any liquid in each lagoon, using the procedure for surface water sampling (SOP-06.13). It is expected that there is approximately a one-ft thickness of sludge in each lagoon. Potential contaminant concentrations could vary from place to place in the sludge. Five samples will therefore be collected from the sludge in each lagoon, using a hand corer (Procedure C-7, Appendix C). Samples will be screened in the mobile laboratory for alpha, beta, and gamma radiation. Any samples showing elevated gamma activity will be analyzed with *gamma spectroscopy* at the analytical laboratory. The laboratory intends to decommission the lagoons (see Section 5.1.5.1.4), and it is therefore necessary to determine whether the sludge is hazardous waste. Thus samples of sludge will be analyzed for toxicity using the toxic characteristics leaching procedure (EPA 1989, 0092). It is not expected that the sludge will evidence any other hazardous waste characteristics (corrosivity, ignitability, or reactivity). Samples of sludge will also be analyzed for radionuclides as indicated in Table 5-4.

5.1.5.1.3 Phase I Sampling of Outfall

The outfall from the lagoons discharged infrequently (Section 5.1.2.1.1), and the outfall discharged directly into a small pond that is part of a wetland area (Section 3.3.4). The sediments and vegetation in this wetland area will be sampled as described in Section 5.7, and no separate sampling specific to the lagoon outfall will be performed.

5.1.5.1.4 Phase II Investigations

At the beginning of Phase II investigations, the manholes, lagoon liquids, and sludges will be removed for appropriate disposal, based on the results of Phase I investigations. This removal and disposal would be approached as a VCA, whether or not potential contaminants of concern were present in these materials. Phase II sampling, done in conjunction with this VCA, will be designed to determine the concentrations of potential contaminants of concern in the lagoon lining (gunite), and the extent of any soil contamination surrounding the manholes or underlying the lagoon liners. Site-specific cleanup levels for soils will be established through risk assessment (Section 4.3), and soil contaminated to above those levels will be removed for appropriate disposal. It is anticipated that by the time such actions are taken, the Laboratory's mobile laboratory capability will be fully developed, and will be applied to conduct of the VCA. If potential contaminants of concern are observed in groundwater during Phase I investigations (Section 5.6), determination of the extent of contamination will be included in Phase II.

5.1.5.2 SWMUs 18-003(a) through (h) - Septic Systems

Little information is available on actual waste discharges to these septic systems. Based on archival data review (Chapter 2), the most likely contaminants in any of these septic systems are oil, uranium, plutonium, and perhaps hazardous materials as presented in Table 5-1. Details of the proposed sampling are presented in Table 5-5. Proposed sampling locations are shown in Figures 5-10 through 5-14. If any of the septic systems evidence contamination by radioactive or hazardous constituents above removal criteria or screening action levels, removal of the structures and contaminated soil will be implemented as VCAs

TABLE 5-5

SAMPLING PLAN FOR SEPTIC SYSTEMS, SWMUs 18-003(a–h)

			Field Survey				Mobile Lab.				Analytical Laboratory											
PRS Number	**PRS Description**	**Sample Description**	Location survey	Geophysical survey	Rad screening (α, β, γ)	VOC screening	No. of sampling locations	Metals	VOCs	SVOCs	No. of sampling locations	Mob. lab. rad. screening (α, β, γ)	Metals (EPA 6010)	HE (USATHMA[a])	General mineral (std. methods)	Chloride—soils (EPA 300)	Nitrate—soils (EPA 300)	Uranium (total) (DOE[d])	Plutonium (isotopic) (DOE[d])	Thorium (isotopic) (DOE[d])	Gamma spectroscopy (DOE[d])	BTEX (EPA 8020)
18-003(a)	Settling pit				X	X																
	TA-18-105	Liquid (if present)									2	X	X					X	X		e	
	(active)	Sludge (if present)									2	X	X					X	X		e	
		Wipes (if dry)									2	X						X	X		e	
		Soils—surface			X		6	X	X	X	3	X	X					X	X		e	
18-003(b)	Septic tank				X																	
	TA-18-39	Liquid				X					2	X	X					X	X		e	
	(active)	Sludge									2	X	X					X	X		e	
		Groundwater									2	X	X		X			X	X		e	
		Soils—surface	X	X[c]	X		16	X	X	X	8	X	X					X	X		e	
18-003(c)	Septic tank				X	X																
	TA-18-42	Liquid									2	X	X					X	X		e	
	(active)	Sludge									2	X	X					X	X		e	
		Ground water									2	X	X		X			X	X		e	
		soils—surface	X	X[c]	X		4	X	X	X	8	X	X					X	X		e	
18-003(d)	Septic tank				X	X																
	TA-18-120	Liquid									2	X	X					X	X		e	X
	(active)	Sludge									2	X	X					X	X		e	X
		Groundwater									2	X	X		X			X	X		e	X
		Soils—surface	X	X[c]	X		16	X	X	X	8	X	X					X	X		e	

a. US Army Toxic and Hazardous Materials Agency, no date, 0522.
b. Maximum number, assuming all sampled locations show contamination.
c. Geophysical surveys may be used to locate drain fields if technology is proven by ongoing RFIs.
d. HASL-300 (DOE 1983, 0516).
e. Only when gross-gamma is above background.

TABLE 5-5 (continued)

SAMPLING PLAN FOR SEPTIC SYSTEMS, SWMUs 18-003(a–h)

			Field Survey				Mobile Lab.				Analytical Laboratory														
PRS Number	**PRS Description**	**Sample Description**	Location survey	Geophysical survey	Rad screening (α, β, γ)	VOC screening	No. of sampling locations	Metals	VOCs	SVOCs	No. of sampling locations	Mob. lab. rad. screening (α, β, γ)	VOCs (EPA 8240)	SVOCs (EPA 8270)	Metals (EPA 6010)	HE (USATHMA[a])	General mineral (std. methods)	Chloride—soils (EPA 300)	Nitrate—soils (EPA 300)	Uranium (total) (DOE[d])	Plutonium (isotopic) (DOE[d])	Thorium (isotopic) (DOE[d])	Gamma spectroscopy (DOE[d])	BTEX (EPA 8020)
18-003(g)	Septic tank				X	X																		
	TA-18-43	Liquid									2	X	X	X	X					X	X		e	
	(active)	Sludge									2	X	X	X	X					X	X		e	
		Groundwater									1	X	X	X	X		X			X	X		e	
		Soils—surface	X[c]	X[c]			6	X	X	X	3	X	X	X	X					X	X		e	
18-003(h)	Septic tank				X	X																		
	TA-18-152	Liquid									2	X	X	X	X					X			e	
	(active)	Sludge									2	X	X	X	X					X			e	
		Ground water									1	X	X	X	X		X			X			e	
		Soils—surface	X	X[c]			6	X	X	X	3	X	X	X	X					X			e	
18-003(e)	Septic tank				X	X																		
	TA-18-40	Liquid									2	X	X	X	X					X	X		e	
	(inactive)	Sludge									2	X	X	X	X					X	X		e	
		Soils—subsurface	X	X[c]	X	X					7	X	X	X	X					X	X		e	
		Groundwater	X	X[c]							2	X	X	X	X		X			X	X		e	
		Sediments			X		4	X		X	2	X		X	X					X	X		e	

a. US Army Toxic and Hazardous Materials Agency, no date, 0522.
b. Maximum number, assuming all sampled locations show contamination.
c. Geophysical surveys may be used to locate drain fields if technology is proven by ongoing RFIs.
d. HASL-300 (DOE 1983, 0516).
e. *Only when gross-gamma is above background.*

TABLE 5-5 (concluded)

SAMPLING PLAN FOR SEPTIC SYSTEMS, SWMUs 18-003(a–h)

PRS Number	PRS Description	Sample Description	Field Survey				Mobile Lab.				Analytical Laboratory													
			Location survey	Geophysical survey	Rad screening (α, β, γ)	VOC screening	No. of sampling locations	Metals	VOCs	SVOCs	No. of sampling locations	Mob. lab. rad. screening (α, β, γ)	VOCs (EPA 8240)	SVOCs (EPA 8270)	Metals (EPA 6010)	HE (USATHMA^{a})	General mineral (std. methods)	Chloride—soils (EPA 300)	Nitrate—soils (EPA 300)	Uranium (total) (DOE^{d})	Plutonium (isotopic) (DOE^{d})	Thorium (isotopic) (DOE^{d})	Gamma spectroscopy (DOE^{d})	BTEX (EPA 8020)
18-003(f)	Septic tank				X	X																		
	TA-18-41	Liquid									2	X			X					X			e	
	(inactive)	Sludge									2	X			X					X			e	
		Soils—Subsurface	X	X^{c}	X	X					8	X			X			X	X	X			e	
		Groundwater	X	X^{c}							2	X			X		X			X			e	
		Sediments			X		4	X		X	2	X			X					X			e	
18-003(f)	Manhole			X																				
	TA-18-93	Sand backfill			X	X					1	X			X					X			e	
	(inactive)	Soil—subsurface			X	X					2	X			X					X			e	
QC samples																								
		Liquid—duplicates									2	X	X	X	X					X	X		e	
		Sludge—duplicates									2	X	X	X	X					X	X		e	
		Groundwater—duplicates									2	X	X	X	X					X	X		e	
		Soils—duplicates									5	X	X	X	X					X	X		e	
		Field blank									1	X	X	X	X					X	X		e	
		Rinsate blanks									1	X	X	X	X					X	X			

a. US Army Toxic and Hazardous Materials Agency, no date, 0522.
b. Maximum number, assuming all sampled locations show contamination.
c. Geophysical surveys may be used to locate drain fields if technology is proven by ongoing RFIs.
d. HASL-300 (DOE 1983, 0516).
e. Only when gross-gamma is above background.

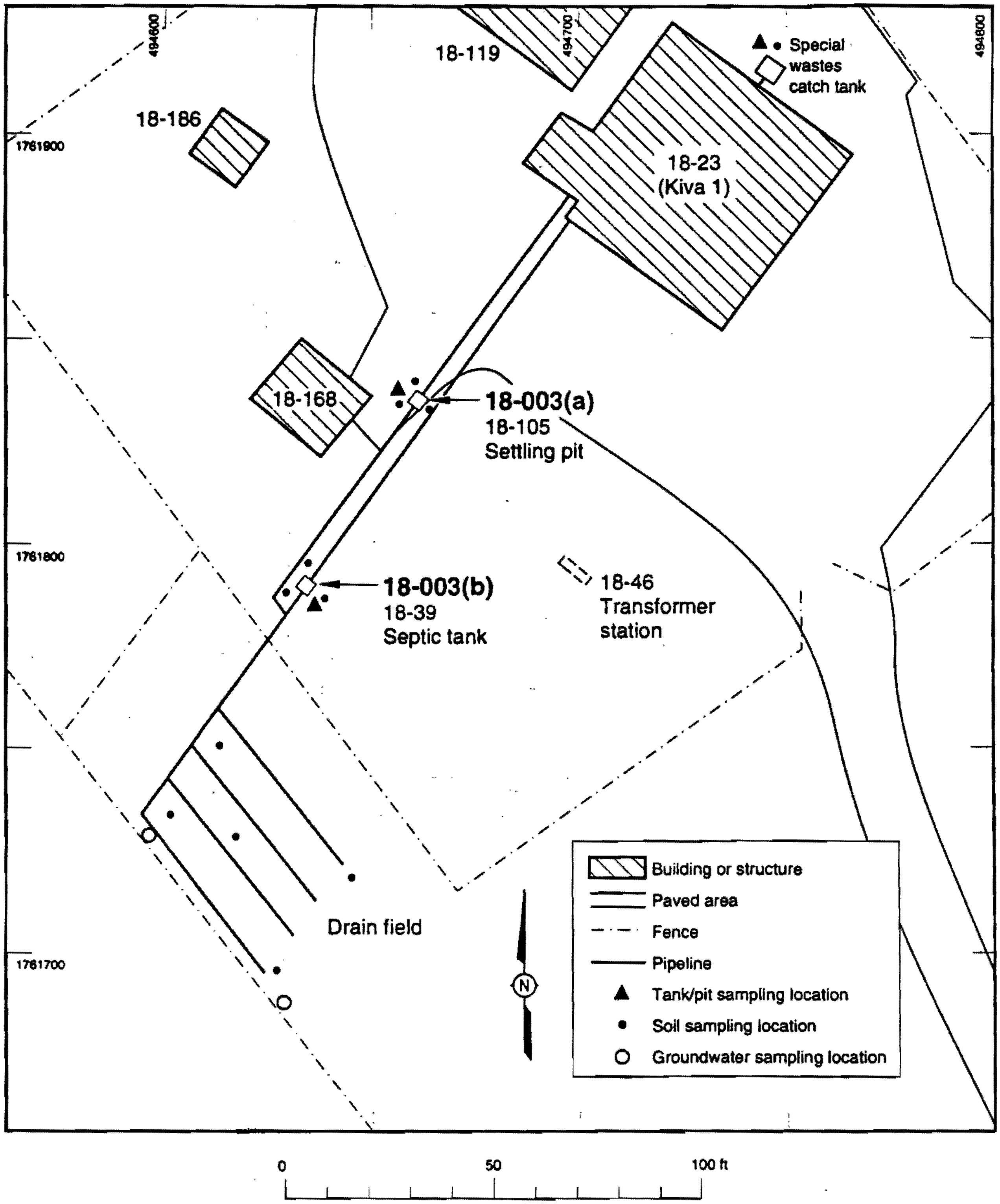


Figure 5-10. Proposed sampling locations at SWMUs 18-003(a and b).

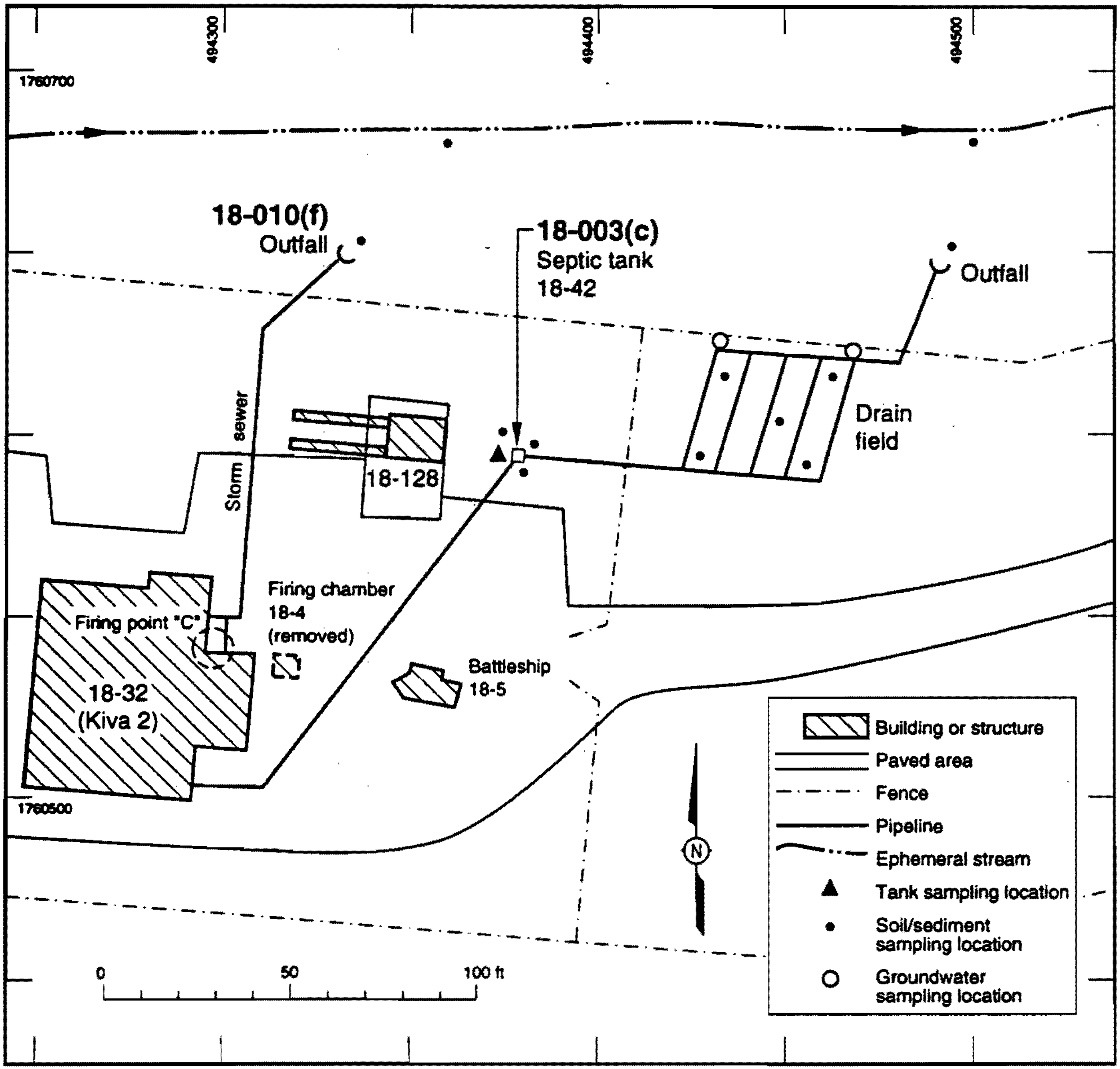


Figure 5-11. Proposed sampling locations at SWMU 18-003(c) and AOC 18-010(f).

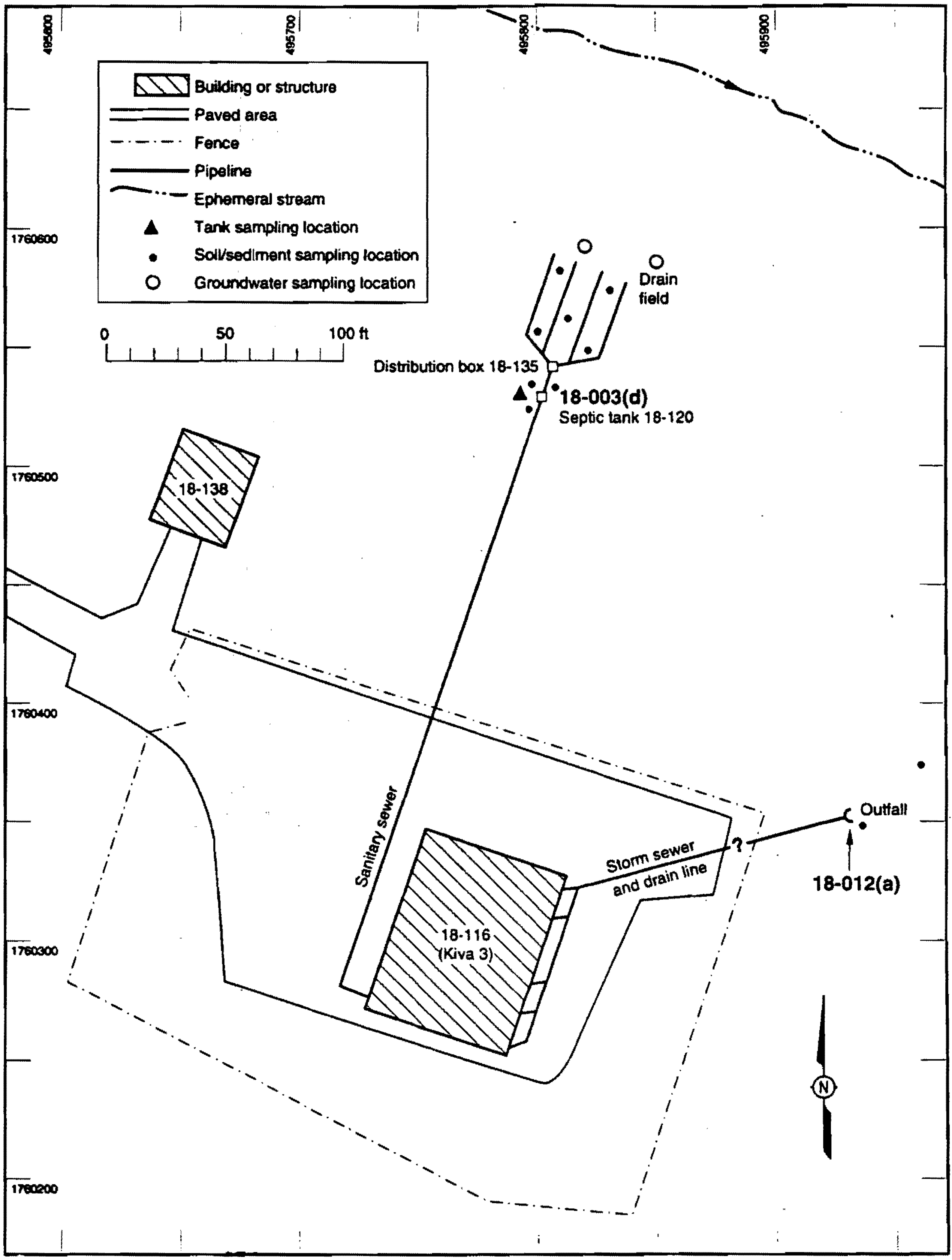


Figure 5-12. Proposed sampling locations at SWMU 18-003(d) and AOC 18-012(a).

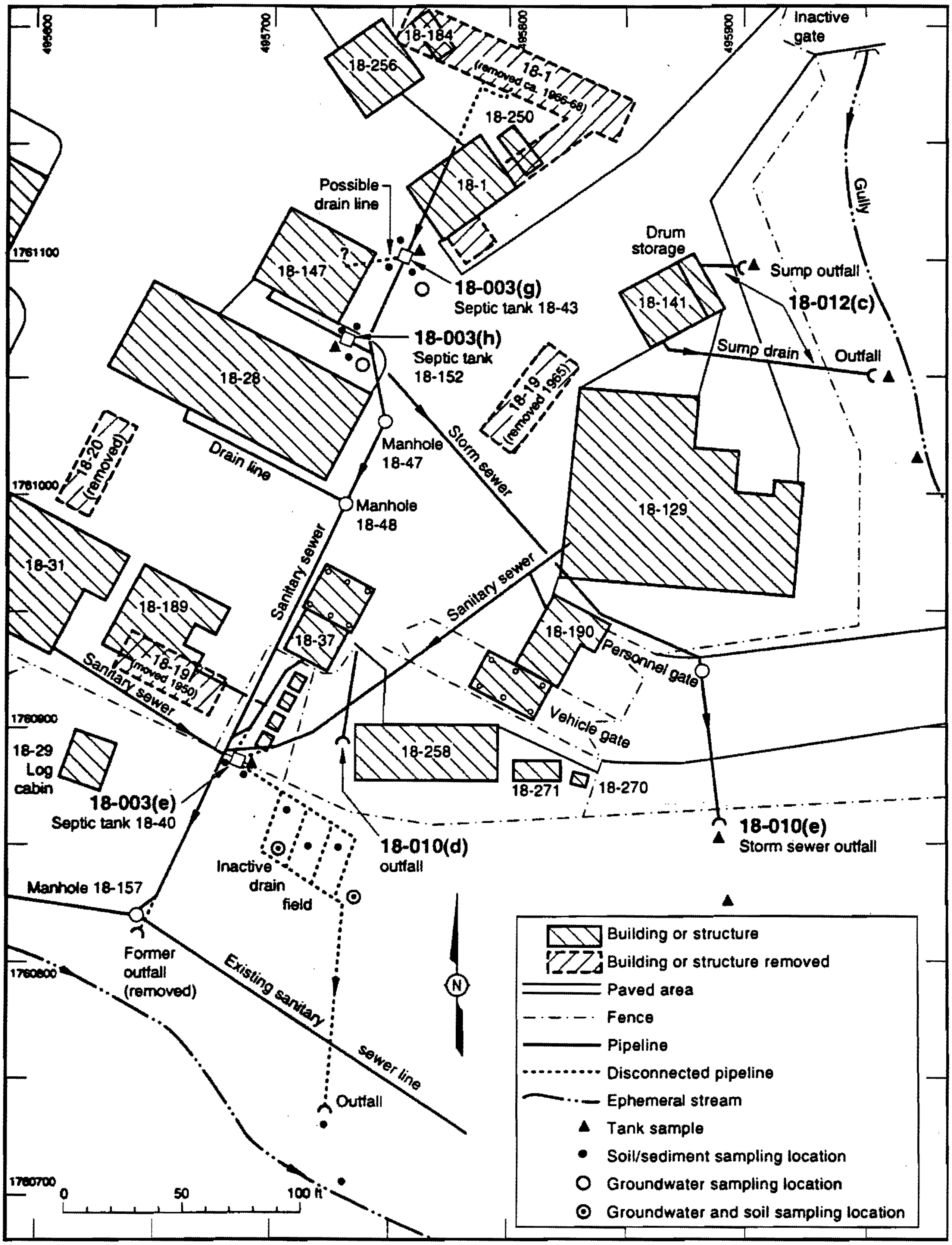


Figure 5-13. Proposed sampling locations in central portion of TA-18.

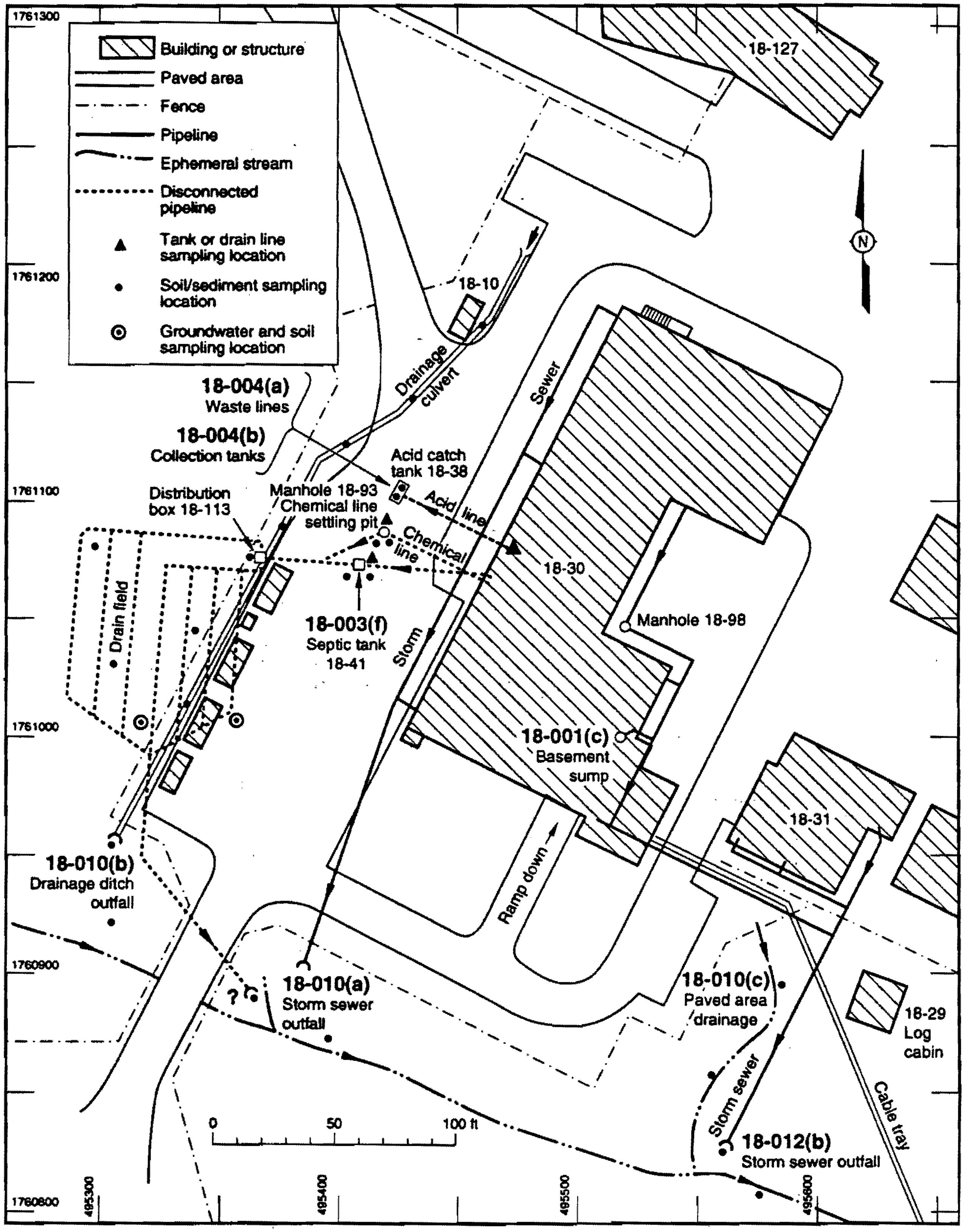


Figure 5-14. Proposed sampling locations near Building TA-18-30.

(Section 4.2.3). The sampling for each septic system will follow the strategies presented in Sections 4.5.1.3 through 4.5.1.8, as appropriate.

5.1.5.2.1 Active Septic Systems

SWMUs 18-003(a), (b), (c), (d), (g), and (h) are active systems. The latter two discharge to the centralized sanitary sewer line, whereas the first four discharge to drain fields. Sampling of these active systems will consist of sampling the contents of the tanks, sampling of surface soils overlying the tanks and drain fields, sampling of surface outfalls from the drain fields, and groundwater sampling to determine if the SWMUs are presently releasing contamination to the shallow groundwater at the site. This sampling is designed to assess the nature of any current health risks at the site, either through potential offsite transport of contaminants, or by exposure of present workers at the site.

Sampling of Septic Tanks and Settling Pit

Before sampling is initiated, the interior space of the tank and pit will be screened for radiation using Procedures C-4 and C-3, Appendix C, and for VOCs using a photoionization detector (PID) (Procedure C-5, Appendix C). For some tanks, this can be done through a manhole, others will require removing the surface cover of the tank. The tank will also be screened for explosive vapors using a combustible gas indicator (CGI). No personnel entry into any tanks is planned.

Because of the fluid mixing inherent to the operation of the tank, it is reasonable to assume that contaminant concentrations are the same in any portion of the liquid in the tank; sludge on the bottom of the tank is more likely to be present nearer the inflow end. If both liquid and sludge are present, both will be sampled. If the tank is essentially dry, wipe samples will be collected from the bottom of the tank below the overflow outlet. (Only the settling pit, TA-18-105, is likely to be dry.) Sampling will use a weighted-bottle sampler (SOP-06.19) for liquids in the tanks, a hand corer for sampling sludge in the bottom of the tank (Procedure C-7, Appendix C), and Procedure C-1, Appendix C, if wipe samples are necessary. Two samples each of sludge, liquid, or wipe (as appropriate) will be collected for submission to an analytical laboratory.

Sampling of Surface Soils

There have been no historical indications of plugging or waterlogging in the active septic systems that could have brought contaminants to the surface. Therefore, no specific preferential locations for sampling can be established. The surface soils overlying the septic tanks and drain fields will be surveyed for gross alpha, beta, and gamma radiation using Procedures C-4 and C-3, Appendix C (see also Section 4.6.4.1) Any locations of elevated readings will be marked for sampling. Field screening for metals, VOCs, and SVOCs will be performed on samples from locations overlaying the septic tank and drain field (Section 4.6.4.2). If no elevated levels are identified, three sampling locations will be selected near each septic tank or settling pit, and five overlying the drain field. Septic Tanks TA-18-43 and -152 are in paved areas; therefore, surface samples will only be taken if elevated radioactivity is detected. Proposed locations for this sampling are illustrated in Figures 5-10, 5-11, and 5-12. The proposed number of sampling locations will provide a 95% confidence of detecting contamination that affects at least 50% of the area (Section 4.5.1.3). If locations of elevated radioactivity readings or metals are identified, they will be included in these locations. Samples will be taken to a depth of 6 in. using a spade and scoop (SOP-06.09).

Sampling of Outfalls

Of the active septic systems, only SWMU 18-003(c) has an outfall from the drain field. SWMUs 18-003(g) and (h) originally discharged through an outfall that was obliterated when these SWMUs were connected to the centralized sanitary line in 1969.

The outfall for SWMU 18-003(c) is in the side of the adjacent drainage in Threemile Canyon (Figure 5-11), within approximately 5 ft of the channel. Before sampling, the drainage-way from the outfall to the main drainage channel will be surveyed for gross alpha, beta, and gamma using Procedures C-4 and C-3, Appendix C (see also Section 4.6.4.1). Field screening for metals and SVOCs will be conducted (see Section 4.6.4.2). Any locations of elevated readings will be sampled. If no such locations are detected, sediment samples will be collected from directly under the outfall, and from a suitable sediment trap between the outfall and the main drainage channel. Samples of sediment to a depth of 6 in. will be collected using a spade and scoop (SOP-06.09). Locations of these samples are indicated in Figure 5-11.

The location of the former outfall from SWMUs 18-003(g) and (h) will be surveyed for radioactivity as described above, and a determination will be made if any remnant of the former discharge channel from the outfall still exists. If any elevated radioactivity metals, or SVOCs is detected, or if a preferred sampling location can be determined based on drainage characteristics, sediment samples will be collected as described above for SWMU 18-003(c).

Groundwater Sampling

Samples of groundwater will be collected at two locations from approximately 2 ft below the water table beneath each of the three active drain fields using a hollow-stem auger and a hydropunch (Procedure C-8, Appendix C). Field measurement of water quality parameters will be performed using SOP-06.02. An attempt will also be made to collect samples from shallow groundwater adjacent to SWMUs 18-003(g) and (h). There is no information on whether shallow groundwater is present at these SWMUs; however, test borings made during construction of Building TA-18-30 suggest the shallow saturated zone may be very thin under the SWMUs. The drain fields represent the most probable source of potential groundwater contamination, but SWMUs 18-003(g) and (h) are sufficiently remote from a drain field to justify separate sampling at their locations. Note that SWMUs 18-003(g) and (h) are believed to have originally discharged directly to surface outfalls (Figure 2-9), but presently discharge to the centralized sanitary waste line. Design drawings also indicate that a single-pipe drain field may have been constructed for SWMU 18-003(g) (Figure 5-13). Two locations will be selected near the downgradient edge of each drain field, and downgradient from SWMUs 18-003(g) and (h). These locations are indicated in Figures 5-10, 5-11, and 5-12 for SWMUs 18-003(a) and (b), 18-003(c), and 18-

003(d), respectively, and in Figure 5-13 for SWMUs 18-003(g) and (h). Although local hydraulic gradients have not been established, the general direction of flow in the shallow groundwater is expected to be eastward and subparallel to the surface drainage, with a possible component of the flow toward the surface drainage-way in some areas (Section 3.6.2.2). Thus, sampling locations were selected along the eastern border of each drain field, along the drain field border closest to the surface drainage, and east of SWMUs 18-003(g) and (h).

Sample Analysis

All collected soil and water samples will be appropriately containerized and submitted to an analytical laboratory for analysis for the potential contaminants of concern, as specified in Table 5-5. Samples will be field screened for gross alpha, beta, and gamma activity using Procedures C-4 and C-3, Appendix C. Any samples showing elevated gamma activity will be analyzed with gamma spectrometry at the analytical laboratory. Water samples will also be analyzed for general mineral content (Section 5.6.3). The results of sample analysis will be used to determine if the current risks associated with the septic systems are acceptable (Section 4.3.3.2). If current risks are acceptable, further investigation will be deferred until the septic systems are deactivated. If risks are unacceptable, a work plan for a VCA will be developed as part of a Phase II investigation.

5.1.5.2.2 Inactive Septic Systems

SWMUs 18-003(e) and 18-003(f) are inactive. Each consists of a septic tank, drain field, and surface outfall (Figures 5-13 and 5-14). A chemical waste line from Building TA-18-30 discharged to a manhole that, in turn, discharged to the drain field associated with SWMU 18-003(f) (Figure 5-14). The tanks and settling pit, drain field soils, and surface outfall areas will be sampled to determine if contaminants are present. Samples of shallow groundwater beneath the drain fields will also be collected.

Sampling of Tanks

The two inactive septic tanks (TA-18-40 and -41) will be sampled using the procedures for tank sampling described in Section 5.1.5.2.1 (Active Septic Systems). Sampling locations are shown in Figures 5-13 and 5-14, respectively. The manhole (TA-18-93) associated with SWMU 18-003(f) (Figure 5-14) was reportedly backfilled with sand sometime after the septic system was abandoned (1969). It has not been possible to establish which residues may have been present in the pit when it was backfilled. If, as expected, sand is present in the settling pit, a hollow-stem auger will be used to obtain a continuous core of the fill material inside the pit, extending to the bottom of the pit, using Procedure C-6, Appendix C. Design drawings of the settling pit could not be located, but the pit is presumed to be approximately 5 ft deep. (The bottoms of septic tanks and manholes are typically 5 to 6 ft below grade.) Should a single 5-ft core be insufficient to penetrate the full thickness of the sand fill, a second core will be taken. The core will be photographed, visually inspected, and surveyed for radioactivity (gross alpha, beta, and gamma) using Procedures C-4 and C-3, Appendix C, and for VOCs using a PID, Procedure C-5, Appendix C. Any portions of the core showing elevated levels, and any portions visibly suggesting the presence of sludge or other residues in the pit, will be sampled. If no areas of elevated levels or obvious staining exist, two axial slices will be removed from the entire length of each 5-ft section of core, and the material from each mixed uniformly. (See Section 4.5.1.5 for a discussion of the rationale for this sampling strategy.) This material will comprise the samples from the core. If the pit has not been backfilled with sand or other material, the pit will be sampled using the methods for tank sampling described in Section 5.1.5.2.1.

Soil Sampling

Soil sampling around the tanks and settling pit and within the drain field will be targeted on areas considered most likely to have received discharges from the tanks or settling pit. Sampling locations will be selected adjacent to the outflow from each tank or pit, adjacent to the tank near the inflow side of the tank, adjacent to the distribution box for SWMU 18-003(f), and within the drain fields for both SWMUs. Proposed sampling locations are illustrated in Figures 5-13 and 5-14 for SWMUs 18-003(e) and (f), respectively.

Soil samples will be collected immediately adjacent to the outflow from each tank, and from the pit. Fluid levels inside the tank may have occasionally risen above the outflow elevation, and a loose joint could have resulted in leakage to the soil. The outflow point will be located by excavation, and a sample will be taken of the soil immediately adjacent to and underneath the outflow pipe to a depth of 2 ft below the pipe using a thin-wall sampler (SOP-06.10). Any fluid escaping the tank at the outflow pipe would be expected to contact the surrounding and underlying soil, and the soil would retain some evidence of potential contaminants escaping the tank. Upon removal from the core sampler, the sample will be field screened for gross alpha, beta, and gamma using Procedures C-4 and C-3, Appendix C, and for VOCs using a PID (Procedure C-5, Appendix C). The sample will be photographed, and visually inspected for evidence of staining or weathering that would suggest that the sampled soil had been affected by discharges from the septic tank. Any portions of the material showing evidence of such discharge, or any portion showing elevated radioactivity or organic content (based on the field screening mentioned above), will be sampled. If no such areas are observed, the entire core will be homogenized and will comprise the sample from that location.

In addition, soil samples will be collected immediately adjacent to each tank near the inflow end of the tank using a hollow-stem auger to collect 5-ft cores to a depth of 10 ft below the surface. The inflow pipe, although less likely to have been under hydraulic pressure than the outflow pipe, also presents a potential leak point from the tank. Sampling beside and below the bottom elevation of the tank serves the additional purpose of potentially intersecting any contaminated soil resulting from leaks of the tank itself. Upon removal from the core unit, the cores will be field screened for gross alpha, beta, and gamma using Procedures C-4 and C-3, Appendix C, and for VOCs using a PID (Procedure C-5, Appendix C). The core will be photographed, and visually inspected for evidence of staining or weathering that would suggest that the sampled soil had been affected by discharges from the septic tank. If any staining is observed, these locations will be selected for sampling. If staining is not present, two axial slices of each 5-ft core will be removed from the full length of the core. These slices will comprise the samples from the core. See Section 4.5.1.5 for a discussion of the rationale for this sampling strategy.

Core samples will be selected from within the drain field at the locations shown in Figures 5-13 and 5-14, using the same approach described above for core adjacent to the tanks. To the extent possible, the borings will be located to intersect individual trenches containing the drain lines, if ground-penetrating radar (GPR) is successful at defining the trench location. Because the drain field soils are the most probable existing source of shallow groundwater contamination, water samples will be collected at two of the drain field sampling locations (see Groundwater Sampling below).

Outfall Sampling

According to the design drawing (LASL 1953, 16-0058), the inactive drain fields were provided with outfalls. The outfall for SWMU 18-003(e) was located, but initial attempts to locate the outfall for SWMU 18-003(f) were unsuccessful. The presumed location of the latter outfall will be carefully probed and hand excavated in an attempt to locate the outfall. If other features, such as roads or pipelines, do not interfere, it may be possible to locate the presumed outflow line from the drain field using GPR. Sampling will be conducted below the outfall for SWUM 18-003(e), and, if it is located, below the outfall from SWMU 18-003(f), as described for outfall sampling for active septic tanks (Section 5.1.5.2.1).

Groundwater Sampling

The upper surface of the shallow groundwater body is expected to be at a depth of approximately 15 ft or less beneath each of the drain fields. (See Section 3.6 for a discussion of water levels in the shallow groundwater body.) Two boreholes in each drain field (Figures 5-13 and 5-14) will be advanced to the water table after soil sampling is completed. The borehole closest to the eastern border of each drain field and the one closest to the adjacent surface drainage in Pajarito Canyon were selected for this sampling, using the same rationale presented in Section 5.1.5.2.1. These locations reflect the most probable direction of groundwater flow beneath the drain field. Groundwater samples will be collected from a depth of approximately 2 ft below the water table using a hydropunch (Procedure C-8, Appendix C). Field measurement of water quality parameters will be performed, using SOP-06.02.

Sample Analysis

All soil and water samples will be properly containerized and submitted to an analytical laboratory for analysis for the constituents of concern. Samples showing elevated gross gamma values in field screening will be submitted for gamma spectroscopy. All water samples will also be analyzed for general minerals regulated by the Safe Drinking Water Act, and soil samples will be analyzed for nitrates and chlorides. These latter constituents, if present at concentrations significantly above site-specific background soil concentrations, would verify that samples were selected from within soil affected by the septic system. (See Section 5.6 for a discussion of sampling to establish these background concentrations.)

If potential contaminant concentrations, when compared with screening action levels, indicate that soil contamination does not present an unacceptable risk, NFA will be proposed for the tanks and immediately adjacent soils, providing that drain field sampling produces comparable results. If any constituent concentrations are above screening action levels, consideration will be given to performing a VCA. However, as shown in Figure 5-14, excavation of soils within the drain field for SWMU 18-003(f) would require relocation of a security fence and removal of substantial amounts of paving. If a VCA appears advisable, it may be possible to defer the VCA until site decommissioning, providing current health risks from this SWMU are acceptable. If deferral of the VCA appears desirable, a Phase II sampling plan will be proposed to establish current risks (Section 4.5.1.8). There are no such features potentially interfering with a VCA at SWMU 18-003(e).

5.1.5.3 SWMUs 18-004(a) and 18-004(b) - Drain Line and Tank

Proposed sampling and analysis at these SWMUs are detailed in Table 5-6, and sampling locations are illustrated in Figure 5-14. Sampling will be performed at the inlet (building) end of the drain line [18-004(a)], and at SWMU 18-004(b), the former location of a concrete pit. As indicated in Section 5.1.1.3, the drain line was believed to have been used only for discharge of nonradioactive acid wastes and cleaning solvents to the collection tanks. The line is believed to be capped on the inlet end. The cap, if present, will be removed, and the interior of the pipe surveyed for beta/gamma radioactivity using Procedure C-3, for removable alpha radioactivity using Procedure C-1, Appendix C, and for VOCs using Procedure C-5, Appendix C. If no radioactivity or VOCs are detected above background levels, further investigation of the drain line will be deferred until building decommissioning. If radioactivity or VOCs are detected, a Phase II investigation of the drain line will be proposed.

All that remains at the previous location of the collection tanks is the concrete floor of the pit (Section 5.1.1.3). The location of the pit, and the former location of the tanks that rested on that pad, will be established with a field survey using engineering drawings. A hollow-stem auger will be advanced to the pad at the location of the tanks, and core samples taken of the concrete that composes the pad. The samples will be submitted to an analytical laboratory. Samples will be field screened for gross alpha, beta, and gamma activity using Procedures C-4 and C-3, Appendix C. Any samples showing elevated gamma activity will be analyzed with gamma spectrometry at the analytical laboratory. If sample analysis indicates that contaminant concentrations are at or below screening action levels, NFA will be proposed for SWMU 18-004(b). If sample analysis indicates contaminants above screening action levels, a Phase II sampling plan may be developed.

TABLE 5-6

SAMPLING PLAN FOR COLLECTION TANKS, SUMPS, DRAIN LINES, AND OUTFALLS

PRS Number	PRS Description	Sample Description	Field Survey							Analytical Laboratory														
			Location survey	Geophysical survey	Rad screening (α, β, γ)	PCB field test	TPH field test	HE field test	VOC screening	No. of sampling locations	Mob. lab. rad. screening (α, β, γ)	VOCs (EPA 8240)	S VOCs (EPA 8270)	Metals (EPA 6010)	HE (USATHMA^a)	General mineral (std. methods)	Chloride—soils (EPA 300)	Nitrate—soils (EPA 300)	Uranium (total) (DOE^d)	Plutonium (isotopic) (DOE^d)	Thorium (isotopic) (DOE^d)	Gamma spectroscopy (DOE^d)	TPH (EPA 418.1)	BTEX (EPA 8020)
18-004(a)	Drain line				X				X															
	(inactive)	Wipes			X					2	X								X			e		
18-004(b)	Collection tanks																							
	(removed)	Concrete core	X		X					2	X	X	X	X					X			e		
18-001(c)	Sump				X				X															
	(active)	Sludge								2	X	X	X	X					X			e		
		Liquid								2	X	X	X	X					X			e		
18-012(b)	Outfall																							
	(active)	Sediments								2	X		X	X					X			e		
18-012(a)	Outfall																							
	(active)	Sediments								2	X			X					X			e		
18-012(c)	Outfall																							
	(active)	Sediments								2	X		X	X					X			e		
18-013	Special wastes	Residues	X		X					2	X			X										
	Catch tank	Soil								2	X	X	X						X			e		
QC samples														X										
		Wipes (duplicate)								1	X								X			e		
		Sludge (duplicate)								1	X	X	X	X					X			e		
		Soil duplicate								1	X	X	X	X					X			e		
		Field blank								1	X	X	X	X					X			e		
		Rinsate blank								1	X	X	X	X					X			e		

a. US Army Toxic and Hazardous Materials Agency, no date, 0522.

b. Maximum number, assuming all sampled locations show contamination.

c. Geophysical surveys may be used to locate drain fields if technology is proven by ongoing RFIs.

d. HASL-300 (DOE 1983, 0516).

e. Only when gross-gamma above is background.

5.1.5.4 Sumps, Acid Drain Lines, and Outfalls

5.1.5.4.1 SWMUs 18-001(c) and 18-012(b) - Sump and Outfall

The sump in Building TA-18-30 and its associated outfall comprise an active system, and no VCA is proposed as part of Phase I investigations. Details of proposed sampling and analysis for these PRSs are presented in Table 5-6, and sampling locations are shown in Figure 5-14. No specific data are available on waste discharges to the sump. Proposed analyses are based on materials used in present and past operations in Building TA-18-30. Before sampling is initiated, the interior space of the sump will be screened for radioactivity using Procedures C-4 and C-3, Appendix C, and for VOCs using a PID (Procedure C-5, Appendix C). The sump will also be screened for explosive vapors using a CGI. No personnel entry into the sump is planned. Two samples of water in the sump will be collected using a weighted-bottle sampler (SOP-06.19). It is not known whether any sediment or sludge is present in the sump. An attempt will be made to sample sludge or sediment with a hand corer (Procedure C-8, Appendix C). If possible, two samples of sediment/sludge will be collected.

Discharge from the sump is combined with other discharges from Buildings TA-18-30 and -31, and is released through an outfall, SWMU18-012(b). The outfall is within approximately 20 ft of the main drainage channel in Pajarito Canyon. Two natural sediment traps will be selected for sampling: one close to the outfall, and the second between the outfall and the main drainage. The sites will be surveyed for radioactivity (Section 4.6.4.1), and samples will be collected for mobile laboratory analysis of metals and SVOCs (Section 4.6.4.2) locations of any elevated readings will be designated for subsequent sampling for submission to an analytical laboratory. Samples will be collected to a depth of 6 in. using a spade and scoop (SOP-06.09).

The samples will be submitted to an analytical laboratory for analysis. Results of the analysis will be used to propose possible Phase II investigations or to propose NFA for these SWMUs. If any contamination is detected in the sump, Phase II investigations will address current risk.

5.1.5.4.2 SWMUs 18-012(a) and (c) - Outfalls

Details of proposed sampling at these SWMUs are presented in Table 5-6, and sampling locations are shown in Figures 5-12 and 5-13 for SWMUs 18-012(a) and AOC 18-012(c), respectively. SWMU 18-012(a) and the easternmost outfall at AOC 18-012(c) will be sampled using the same approach for outfalls as that for the active septic systems (Section 5.1.5.2.1). These outfalls discharge to surface drainages. One of the outfalls at AOC 18-012(c) discharges to a dry well sump. Samples will be collected at two locations from the top 12 in. of fill in the sump using a hand-operated, thin-wall sampler (SOP-6.10).

Samples will be field screened for gross alpha, beta, and gamma activity using Procedures C-4 and C-3, Appendix C. Any samples showing elevated gamma activity will be analyzed with gamma spectrometry at the analytical laboratory.

All samples will be submitted for analysis to an analytical laboratory. Results of the analysis will be used to propose possible Phase II investigations or to propose NFA for these PRSs.

5.1.5.4.3 Special Wastes Catch Tank in Kiva 1

An attempt will be made to locate the concrete pit housing the open-topped catch tank outside Kiva 1 by excavating in the alleged location of the tank (Figure 5-10). The position of a drain that is supposed to lead to the pit from inside the building will be used to locate the tank. If the pit is located, and if a collection tank is present, any residuals in the tank will be sampled. If the pit is discovered, whether or not the tank is present, the tank soils will be field screened for gross alpha, beta, and gamma using Procedures C-4 and C-3, Appendix C. Two samples will be collected of soil in the 0 to 6 in. depth in the bottom of the pit. Two samples will also be taken of any residues in the tank. As indicated in the sampling plan, Table 5-6, all samples will be submitted to an analytical laboratory for analysis of radionuclides and metals, and also for VOCs for the soil samples. Gamma spectroscopy will be conducted if elevated gross gamma levels are observed. No information could be obtained on the possible wastes discharged to the tank, but discussions with site personnel indicate that the tank has not been used for a number of years. Any VOCs discharged would not be expected to remain in the collection tank, but if wastes had overflowed the tank, VOCs could be present in the underlying soil.

5.2 PRS Aggregate "B" - AOC 18-008 - Underground Storage Tank

5.2.1 Description and History

According to engineering drawings (LASL 1952, 16-0024; LASL 1952, 0061), this 1,000-gal. steel underground storage tank (TA-18-104) was located approximately where Building TA-18-250 is presently, and was used to store fuel for diesel-operating generators. The tank was abandoned in 1966, and was thought to have been removed (Table 5-7); however, engineering records indicate that it was not removed. Discussions with site personnel in 1992 (Hesch 1992, 16-0029) indicated that the suspected location of this tank is more likely 40 ft north of Building TA-18-250 (Figure 5-5). A partially buried metal pipe, visible at the approximate suspected location of the tank, may be connected to it. No excavations have been performed to verify this.

5.2.2 Conceptual Exposure Model

The significance of any soil contamination surrounding the tank will be evaluated using screening action levels and standards for total petroleum hydrocarbons (TPH) (NMED 1992, 16-0051). The conceptual exposure model for this scenario is illustrated in Figure 4-3.

TABLE 5-7

PRS AGGREGATE "B"—UNDERGROUND STORAGE TANK

PRS No.	PRS Title	Structure No.	Operational Status	Period Used	Suspected Contaminants
18-008	Underground storage tank	TA-36-104	Inactive	1950?–1966	Diesel fuel

5.2.2.1 Existing Information on Nature and Extent of Contamination

The tank was in use from the late 1950s until 1966. Until site characterization yields information that there were no releases, it must be assumed that the tank leaked while in operation.

5.2.2.2 Potential Pathways for Contaminant Migration

A conceptual model of contaminant transport from underground storage tanks is presented in Figure 4-3. Release through leaks or spills would produce soil contamination, which could be mobilized by percolation of precipitation or by soil erosion. Potentially contaminated media are soils, stream channel sediments, and groundwater.

5.2.3 Remediation Alternatives and Evaluation Criteria

Consistent with the ER Program for removing underground storage tanks addressed by the state of New Mexico's underground storage tank program, this tank, if present, will be removed as a VCA. Because the tank was taken out of service before 1970, it is not formally included in the Laboratory's underground storage tank program; however, at the time the program was implemented at the Laboratory, an unsuccessful attempt was made to locate this tank. It is suspected that the tank is in an open area and is not situated under any present structure. The procedures for sampling and removing of residual soil contamination will be consistent with guidance provided by the state of New Mexico (NMED 1992, 16-0051).

5.2.4 Data Needs and Data Quality Objectives

The objective of the VCA proposed as part of Phase I investigations is to accomplish removal of the tank and any residual soil contaminant consistent with state guidance, as discussed in Section 5.2.3. All sampling and analysis will be consistent with that guidance. Quality control samples (splits, duplicates, equipment blanks, and transportation blanks) will also be collected, as discussed in Annex II, Quality Assurance Project Plan.

5.2.5 Sampling Plans AOC 18-008

Details of the proposed VCA, sampling, and analysis are presented in Table 5-8. This sampling and analysis is consistent with guidance developed by the state of New Mexico for closure of leaking underground storage tanks (NMED 1992, 16-0051; New Mexico Environmental Improvement Board 1990, 0644). Excavation will be conducted at the suspected location of the underground storage tank (Figure 5-5). If the tank is at that location, it will be removed. If the tank is not at that location, reasonable efforts will be made, using a geophysical survey (Section 4.5.1.2), to locate the tank in the vicinity of its suspected location. If the tank is not located by this method, NFA will be proposed.

TABLE 5-8

SAMPLING PLAN FOR AOC 18-008, UNDERGROUND STORAGE TANK

			Field Survey							Analytical Laboratory														
PRS Number	**PRS Description**	**Sample Description**	Location survey	Geophysical survey	Rad screening (α, β, γ)	PCB field test	TPH field test	HE field test	VOC screening	No. of sampling locations	Mob. lab. rad. screening (α, β, γ)	VOCs (EPA 8240)	SVOCs (EPA 8270)	Metals (EPA 6010)	HE (USATHMA[a])	General mineral (std. methods)	Chloride—soils (EPA 300)	Nitrate—soils (EPA 300)	Uranium (total) (DOE[d])	Plutonium (isotopic) (DOE[d])	Thorium (isotopic) (DOE[d])	Gamma spectroscopy (DOE[d])	TPH (EPA 418.1)	BTEX (EPA 8020)
18-008	Underground storage tank																							
		Soils	X	X			X			3[b]	X												X	

a. US Army Toxic and Hazardous Materials Agency, no date, 0522.
b. Minimum number, assuming no leaks are detected.
c. Geophysical surveys may be used to locate drain fields if technology is proven by ongoing RFIs.
d. HASL-300 (DOE 1983, 0516).
e. Only when gross-gamma is above background.

If the tank is located, it will be exposed by excavating around its perimeter. During the excavation, care will be taken to note any visibly stained areas. Visibly stained soil will be removed, and soil beyond the stained area will be field tested for TPH using the Hanby Method (Procedure C-10, Appendix C). When the tank is fully exposed, appropriate means of removing the tank will be established based on its condition and physical characteristics. The tank will be removed from the excavation and cleaned as appropriate for eventual disposal. After the removal of the tank, any visibly stained soil will be excavated, and soil samples will be collected below the stained area. These samples will be field-tested for TPH as described above. Excavation will continue, if necessary, until field screening indicates TPH levels below 100 ppm. (Cleanup standard stipulated by the state of New Mexico [NMED 1992, 16-0051; New Mexico Environmental Improvement Board 1990, 0644]). Confirmatory samples will be collected from below the excavated areas and submitted to an analytical laboratory. If contamination suggestive of extensive leakage from the tank is observed, a Phase II groundwater investigation will be conducted. If no soil staining is apparent, samples will be collected at three equally spaced locations under the center line of the tank. The samples will be field tested for TPH. If TPH levels are below 100 ppm, confirmatory samples will be collected and submitted to an analytical laboratory.

If feasible, based on slope stability and site safety concerns, the excavation will remain open until laboratory results are returned. If laboratory results indicate adequate cleanup, or confirm the absence of contamination above screening action levels or TPH standards, the excavation will be backfilled, and the site proposed for NFA.

5.3 PRS Aggregate "C" for TAs-18 and -27 - Inactive Firing Sites, Magazine Site, and Generator Site

All PRSs in this aggregate consist of areas potentially containing surface contamination from explosive testing of devices or from possible solid discharge of radioactive or hazardous materials from buildings. These PRSs were aggregated on the basis of their similarity regarding the location of potential contamination, and in some instances, because identical sources of material were responsible for the surface contamination. Because of this relationship, the sampling strategies applied to these PRSs will be similar.

5.3.1 Description and History

Some of the materials discharged at these PRSs consisted of explosives, uranium, beryllium, thorium, and lead. Known or suspected contaminants at these former sites, as documented in Chapter 2, are listed in Table 5-9. A discussion of the probable composition of explosives used and their residuals is presented in Section 4.3.1.

5.3.1.1 Firing Sites, Drop Tower, and Former Magazine

There were two firing sites in TA-18: one in Pajarito Canyon [SWMU 18-002(a)], and one in Threemile Canyon [SWMU 18-002(b)] (Figures 5-2 and 5-3,

TABLE 5-9

PRS AGGREGATE "C"—FIRING SITES, MAGAZINE, AND GENERATOR SITE

PRS No.	PRS Title	Structure No.	Operational Status	Period Used	Suspected Contaminants
18-002(a)	Firing site	TA-18-2, -3	Inactive	1944–1945	U, Th, HE residuals, Pb, Be
18-002(b)	Firing site	TA-18-4, -5	Inactive	1944–1945	U, Th, HE residuals, Pb, Be
18-002(c)	Drop tower	NA	Inactive	1944–1945	HE residuals, Pb, Be
18-005(a)	Magazine site	TA-18-15	Inactive	1945–1977	U, Beryllium oxide
18-011	Contaminated soil	TA-18-22	Inactive	1946–1950	Hg
27-002	Firing sites	NA	Inactive	1945–1947	HE and residuals, Pb, Be, U, Th

respectively). Between 1944 and 1945, these sites were used for test shots involving up to several hundred pounds of high explosives (HE). A drop tower, AOC 18-002(c), is believed to have been used in conjunction with the firing site in Threemile Canyon. A magazine facility, Building TA-18-15 (SWMU 18-005), was first used by the firing group and was later used as a storage building for contaminated materials. At TA-27, about 1 mile east of TA-18, there were five firing pits in Pajarito Canyon. Explosive experiments conducted in these pits ranged from a few pounds to a maximum of 2 tons (DOE 1987, 0264).

5.3.1.1.1 SWMU 18-002(a) - Firing Site

This firing site was in Pajarito Canyon near the present location of Kiva 1 (Figure 5-2). The site consisted of TA-18-3, a small firing chamber made from 1-in.-thick steel and measuring 2 ft wide by 2 ft long by 2.2 ft high, and an armored bunker (TA-18-2), commonly referred to as a battleship, which was used for protection of shot instrumentation. The site was used for charges of a few pounds of HE. The firing chamber was open on the top and set flush with the ground a few feet west of the prow of the battleship. The battleship is designated "source storage" in a historical log of TA-18 buildings (LANL, no date, 16-0066) and, therefore, may have held radioactive sources. The firing chamber was reportedly removed in 1945, but the battleship remains. Information on decommissioning of this site is not available. According to the SWMU Report (LANL 1990, 0145), it is speculated that any residual contaminant concentrations will be small. The ground surface in the vicinity of the firing chamber has been substantially regraded and partially paved in association with the construction of Kiva 1 (Building TA-18-23).

5.3.1.1.2 AOC 18-005(a) - Former Magazine Site

This AOC was originally a magazine for the former firing site east of Battleship TA-18-2 (Figures 1-2 and 2-3). Materials later stored in Building TA-18-15 contained uranium and beryllium oxide. The SWMU Report (LANL 1990, 0145) indicates that there is a slight possibility that residues may be present in the area surrounding this former building. As discussed in Chapter 2, there is no evidence of any releases from this building, either during its operational lifetime or during decommissioning (DOE 1987, 0264). It is not known if any sampling was done to verify the presence of contamination. The building was demolished in 1977.

5.3.1.1.3 AOC 18-011 - Contaminated Soil Beneath Former Structure

A generator building (TA-18-22) was reportedly contaminated with mercury in mid-1950 (LANL 1990, 0145). The building was removed in 1950 (LANL, no date, 16-0066), but the concrete pad is still in place. The location of this AOC is shown in Figure 5-5. The SWMU Report (LANL 1990, 0145) indicates that mercury was handled in Building TA-18-22; however, according to a Laboratory employee (Hesch 1992, 16-0029) mercury was only present in some of the switches on the generator. He indicated that, on one occasion, one of the glass tubes that contained mercury on one of the switches broke, spilling 1 to 2 cm^3 of mercury onto a concrete pad that supported the generator and, possibly, onto the surrounding soil. H-Division reportedly cleaned up the mercury spill using sulfur powder; however, no documentation of the spill or of any cleanup effort could be located. A summary description of this AOC is presented in Table 5-9.

5.3.1.1.4 PRSs 18-002(b) and (c) - Firing Pads, Firing Chamber, and Drop Tower

The former firing site in Threemile Canyon, near the present location of Kiva 2, consisted of TA-18-4, a small firing chamber, and a battleship, TA-18-5, (Figure 5-3). The firing chamber was a 1-in.-thick steel box, measuring 2 ft wide by 2 ft long by 2 ft high, that was open on top and was positioned flush with the ground a few feet west of the armored prow of the battleship (an armored bunker used for protection of shot instrumentation). TA-18-16, a ground-level wooden building east of the battleship, was the battery building for the firing site cable conduit system. It contained racks of lead-acid batteries. The firing chamber was removed in 1945, and the battery building in 1951, but the battleship remains.

Three firing pads, not identified in the SWMU Report (LANL 1990, 0145), are shown in engineering drawings (Section 2.4.1 and Figure 5-3). Firing point C was 51 ft west of the nose of TA-18-5, on its midline, and firing point G was 145 ft west of TA-18-5, on its midline. The last firing point, used for the larger charges, was 478 ft west of TA-18-5 and 15 ft north of its midline. The firing site was built to handle charges of up to 2 tons of HE. A drop tower was used in tests involving inert HE and ballistic objects. The tower was probably west of TA-18-5 at one of the three firing pads. The firing pads were removed sometime before the construction of Kiva 2 (late 1940s). Underground cables, some of which may still be in place, connected each pad to TA-18-16, the battery building east of battleship TA-18-5. There have been no recent surveys to determine the extent of contamination at the firing sites (DOE 1987, 0264).

5.3.1.1.5 SWMU 27-002 - Firing Sites

Firing sites were at five separate positions in TA-27, east of TA-18 (Figure 1-4), and were used from 1944 to late 1946 or early 1947 (Section 2.2.1). The sites were shallow pits in which explosive test devices were placed. Two control buildings, one of which is designated AOC 27-004, were associated with these firing pits. All of the firing pits, except Firing Pit 4, have been filled in. Pajarito Road, passing by the sites, has been relocated from its 1947 location, and although there has been significant excavation for removal of gravel from the vicinity of the firing pits, none of the pits underlies the present alignment of the road.

5.3.2 Conceptual Exposure Model

Phase I sampling will be aimed at establishing the presence or absence of radioactive or hazardous contaminants for comparison with screening action levels. A discussion of screening action levels is presented in Section 4.3.

5.3.2.1 Existing Information on the Nature and Extent of Contamination

5.3.2.1.1 Firing Sites - 18-002 and 27-002

Shots were conducted between 1944 and 1947 at these sites, and potential contaminants include HE, uranium, thorium, beryllium, cadmium, and lead. The potential contaminants associated with HE and their degradation products are described in Section 4.3.1.1.1 According to the SWMU Report (LANL 1990, 0145), in 1946, Firing Pit 1 at TA-27 (Figure 1-4) was contaminated by HE from a shot that went low-order (did not detonate completely) (Section 2.2.1). The HE was scattered up to 250 yards in radius. Pieces of HE were collected for disposal during surface sweeps in the 1960s and 1970s.

A radiation survey of all existing structures at TA-27 was conducted in 1959. Only Control Building TA-27-2 evidenced any significant radioactive contamination (Figure 1-4) (Section 6.1.8.1).

In a 1962 inspection of TA-27 (Rogers and Urizar, 1962 16-0064), fragments of old HE, altered by weathering, were recovered and analyzed. They were coated with reddish crystals more sensitive than the original Composition B, similar to RDX explosive. There was concern that this rendered the fragments more sensitive to impact. The HE's TNT component had stained the soil, forming a brown ring around partly buried pieces and enabling them to be located in the grass. No evidence was found of any prior attempt to retrieve the HE scattered at TA-27. Surface sweeps to collect it were begun and continued into the 1970s.

Alpha radiation surveys and sampling conducted in 1985 at TA-27 indicated background levels for uranium in soil at Firing Sites 1, 4, and 5; however, uranium levels at Firing Sites 2 and 3 were 2 to 10 times greater than background (DOE 1987, 0264). No surveys have been performed of firing sites in TA-18.

5.3.2.1.2 AOC 18-011 - Contaminated Soil

In 1950, a reported mercury spill is believed to have resulted from the breakage of an electrical switch assembly (Hesch 1992, 16-0029). The amount of mercury spilled was approximately 1 to 2 cm^3. The spill was reportedly cleaned up by applying sulfur powder to absorb the mercury and transporting this mixture to a disposal area; however, no formal documentation of that cleanup exists. Although it is unlikely that any residual mercury exists at or near the location of the former building after 50 years, no data exist to verify this.

5.3.2.2 Potential Pathways for Contaminant Migration

As illustrated in Figure 4-3, removal of contamination from the ground surface by soil erosion and dissolution in runoff or resuspension into the air are the primary migration pathways for this PRS aggregate. Contamination would be present in stream channel sediments or in surface soils, and transport through the soil to underlying shallow groundwater is possible. A substantial quantity of gravel has been removed from the TA-27 site or used in the construction of the present roadbed for Pajarito Road, which passes through the site.

5.3.3 Remediation Alternatives and Evaluation Criteria

If radioactive or hazardous constituents are present below screening action levels, NFA will be proposed for these sites. If the concentrations are above screening action levels, a Phase II investigation could be conducted, leading to a baseline risk assessment. The areas around these firing sites and impact areas, if contaminated to unacceptable levels, could be excavated for appropriate treatment or disposal (Section 4.4.2).

5.3.4 Data Needs and Data Quality Objectives

The only data requirements for Phase I investigations are those required to evaluate health and safety risks. A screening assessment will be performed to determine the presence or absence of contaminants and, in some instances, their spatial distribution.

As discussed in Section 4.3, potential contaminants of concern originally deposited to the soil may remain in the soil, may have been transported to stream channels by erosion, or may have been leached to the shallow groundwater by percolating precipitation. Some natural degradation of many of the potential contaminants of concern may have occurred. Potential contaminants of concern at AOC 18-011 (the mercury spill) would have originally been localized to the perimeter of the concrete pad on which the generator was mounted. Residual materials from the firing site activities would have been distributed over a wide area. The highest concentrations of these residuals can be expected at the location of the firing sites, and the concentrations are expected to decrease sharply with distance from the firing sites. Sampling objectives for the PRSs in this aggregate will thus be threefold: to determine if concentrations of potential contaminants of concern at the locations of the probable maximum values exceed screening action levels; to develop information on the change in concentration of potential contaminants of concern with distance from the firing sites; and to determine if transport of potential contaminants of concern by surface water or groundwater has resulted in concentrations in sediments or groundwater above screening action levels.

If all measured concentrations of potential contaminants of concern in soil, sediment, and water are below screening action levels, NFA will be proposed for these release sites. Sampling will be designed to test the hypothesis that there is a probability of 95% that soil contamination is present within at least 50% of the potentially contaminated area for small sites, and over smaller percentages for larger sites. The sampling plan thus provides a high probability of detecting pervasive contamination. If any measured concentrations are above screening action levels, consideration will be given to a Phase II investigation leading to a baseline risk assessment. If areas of contamination are of limited size, a VCA could be proposed in lieu of a Phase II investigation.

Quality control samples (splits, duplicates, equipment blanks, and transportation blanks) will also be collected, as discussed in Annex II, Quality Assurance Project Plan.

5.3.5 Sampling Plans

5.3.5.1 Firing Sites - SWMUs 18-002(a) and (b) and 27-002

Proposed sampling for these SWMUs is detailed in Table 5-10. Sampling locations are illustrated in Figures 5-15 and 5-16. The selection of these locations is based on the sampling design presented in the following paragraphs.

Information is not available on the exact nature of the experiments at these sites, and it is, therefore, not possible to estimate with any accuracy the probable spatial distribution of any soil contaminants associated with these sites. In addition, there has been significant ground disturbance–excavation of fill materials, regrading, and new construction–at all the sites. The original distribution of any soil contamination is likely to have been significantly altered by this disturbance. Streamflow and sediment transport have potentially removed material deposited in the stream channel, or such material could be held in bottom sediments in the wetland areas. The possible presence of potential contaminants of concern in groundwater from the firing site activities will implicitly be evaluated through the Phase I sampling program for septic systems (Sections 5.1.5.2.1 and 5.1.5.2.2) or in the OU-wide groundwater sampling program (Section 5.6).

The area potentially affected by the firing site activities was divided into three portions: relatively undisturbed areas where only soil erosion and dissolution in runoff or infiltration may have affected original soil concentrations, areas disturbed by construction where original surface concentrations have been significantly altered, and drainage channels where significant water and sediment transport have occurred.

The presence of potential contaminants of concern in the stream channel sediments will be evaluated as part of the wetland area sampling (Section 5.7). The objective of Phase I sampling of the remaining area affected by the firing site activity is to evaluate concentrations of potential contaminants at locations of probable maximum values, and changes with distance from these locations. Thus, areas where significant surface disturbance has occurred were excluded from the Phase I sampling. The area within which sampling will occur is illustrated in Figures 5-15 and 5-16.

TABLE 5-10

SAMPLING PLAN FOR PRS AGGREGATE C

PRS Number	PRS Description	Sample Description	Field Survey				Mobile Lab.				Analytical Laboratory													
			Location survey	Geophysical survey	Rad screening (α, β, γ)	VOC screening	No. of sampling locations	Metals	VOCs	SVOCs	No. of sampling locations	Mob. lab. rad. screening (α, β, γ)	VOCs (EPA 8240)	SVOCs (EPA 8270)	Metals (EPA 6010)	Mercury (EPA 7471)	HE (USATHMA^a)	General mineral (std. methods)	Chloride—soils (EPA 300)	Nitrate—soils (EPA 300)	Uranium (total) (DOE^d)	Plutonium (isotopic) (DOE^d)	Thorium (isotopic) (DOE^d)	Gamma spectroscopy (DOE^d)
18-002(a)	Firing site		X		X																			
		Soils					22	X		X	11	X			X		X				X		X	e
18-002(b)	Firing site		X		X		30				15	X			X		X				X		X	e
		Soils																						
27-002	Firing sites		X		X																			
		Soils					68	X		X	34	X			X		X				X		X	e
18-005(a)	Magazine site		X		X																			
		Soils					10	X		X	5	X			X		X				X		X	e
18-011	Generator building																							
		Soils	X				10	X		X	5	X				X								e
QC samples																								
		Soil—duplicates									6	X			X		X				X		X	e
		Rinsate blanks									6	X			X		X				X		X	e

a. US Army Toxic and Hazardous Materials Agency, no date, 0522.
b. Maximum number, assuming all sampled locations show contamination.
c. Geophysical surveys may be used to locate drain fields if technology is proven by ongoing RFIs.
d. HASL-300 (DOE 1983, 0516).
e. Only when gross-gamma is above background.

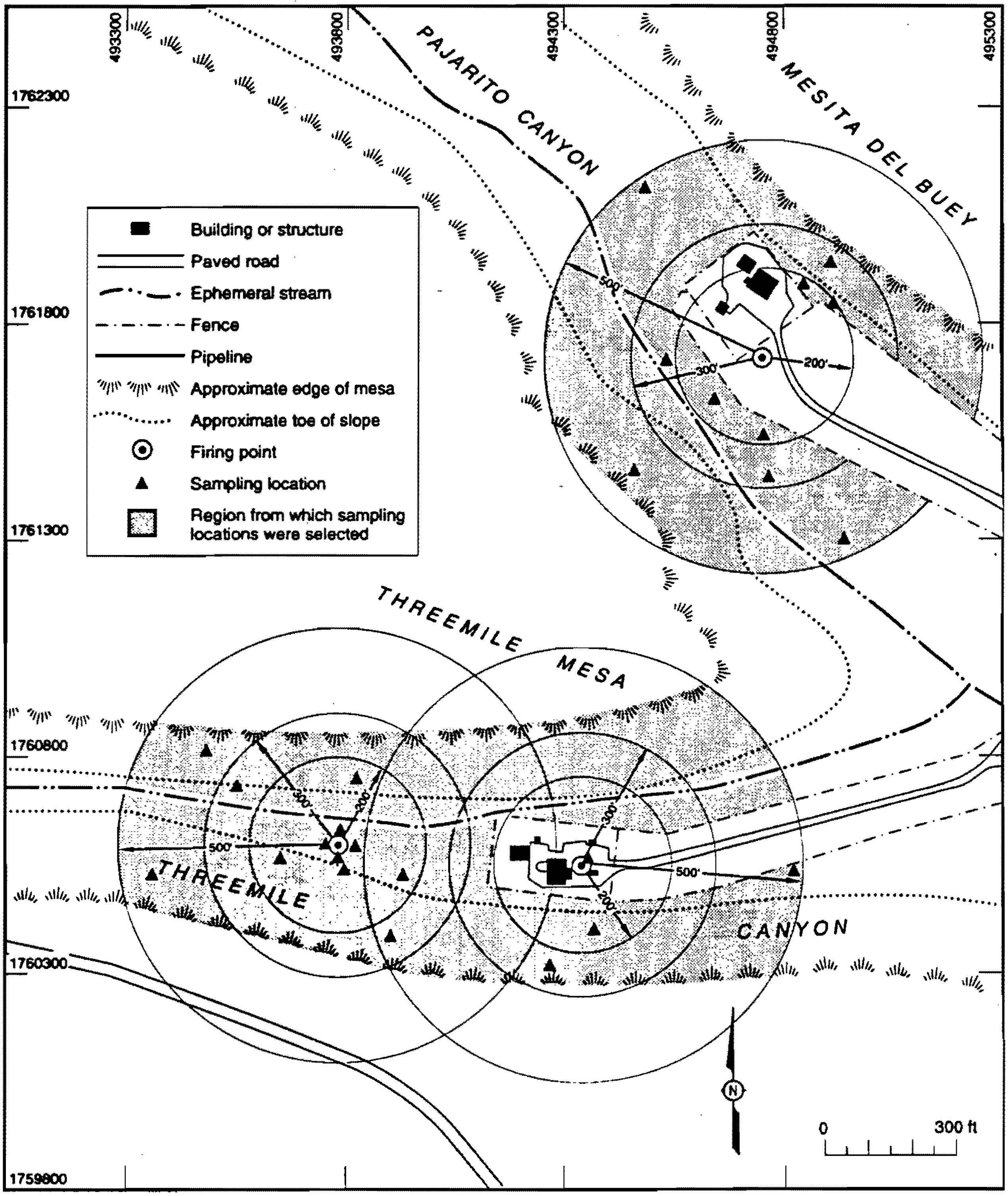


Figure 5-15. Proposed sampling locations near former firing sites in TA-18.

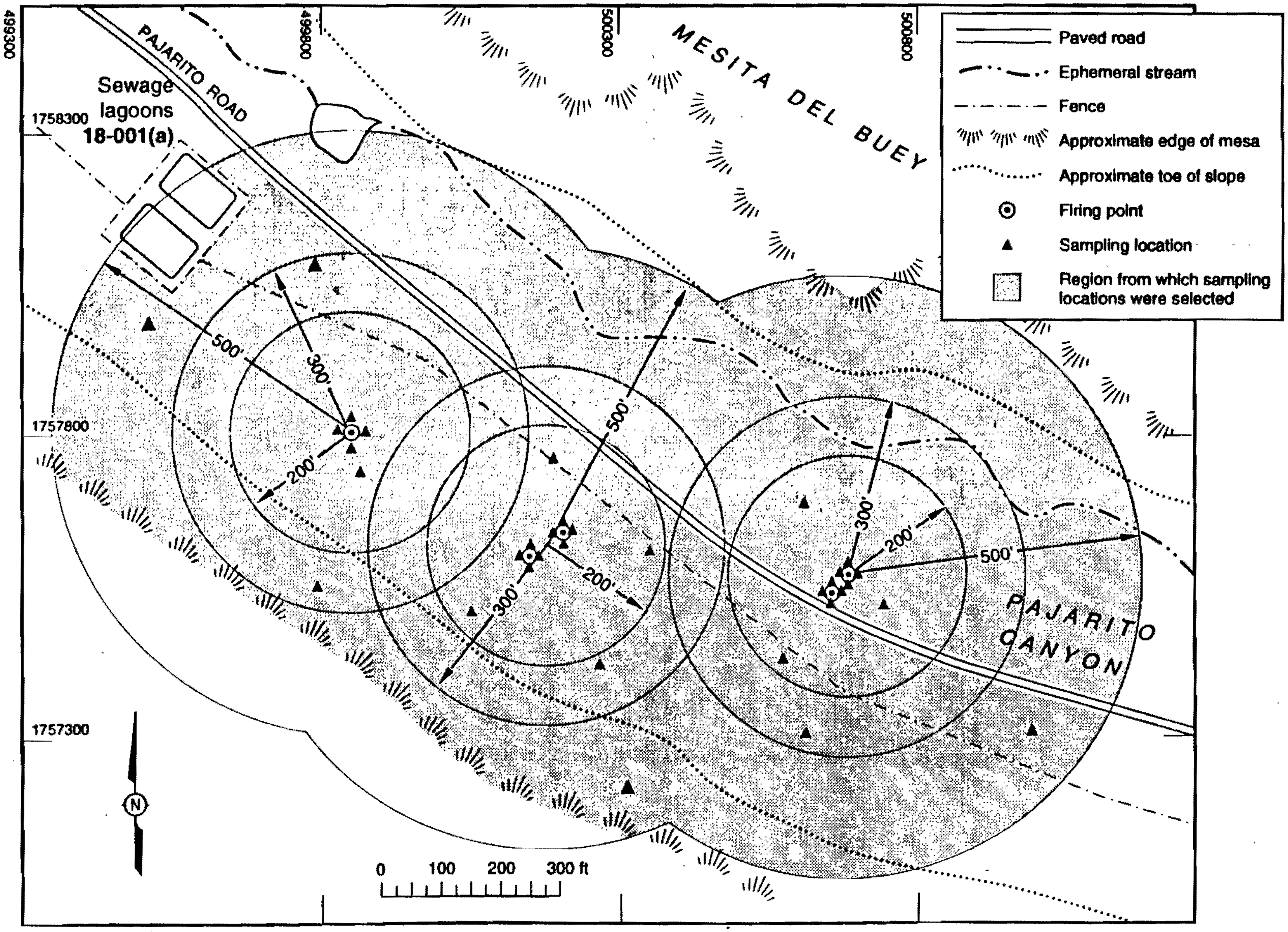


Figure 5-16. Proposed sampling locations near firing sites in former TA-27.

5.3.5.1.1 Sampling at Firing Points

The westernmost firing point near Kiva 2 in Threemile Canyon (Figure 5-15) and all five firing points in former TA-27 (Figure 5-16) have been relatively undisturbed by construction activities. The former site near Kiva 1 in Pajarito Canyon and two of the sites near Kiva 2 were significantly altered through landscaping and paving when the kivas were constructed. Further, the site at Kiva 1 and the one closest to the battleship at Kiva 2 incorporated steel firing chambers. These would have prevented direct penetration of explosives into the soil. Thus, sampling to establish soil concentrations at locations of probable maximum values will not include the firing point near Kiva 1 and the two closest to Kiva 2. At the westernmost firing site in TA-18, a surface firing pad was used. At the firing sites in TA-27, open, unlined shallow pits were used. For both the surface pad and the unlined pits, residues from the experimental firing may have been driven forcibly into the soil, rather than just deposited on the surface. Characterization of the distribution of potential contaminants with depth is therefore desirable near these firing sites.

Five sampling locations will be selected at each of the six firing points in undisturbed areas: one at the approximate center of the firing point, and four at a distance of 10 ft from the center. (The equipment and facilities at these firing points typically occupied a space of 5 to 10 ft on a side; thus, a separation distance of 10 ft between the center and the peripheral sampling locations will encompass the probable locale of the firing points while allowing for some error in locating the center of the firing point.) The firing points will be located by using engineering drawings and surveys, by inspecting available aerial photographs (some of which show the actual firing points, others of which indicate areas of disturbed vegetation at the firing points), and by performing ground inspections. Radiological surveys for alpha, beta, and gamma radiation will be performed at each firing pad location, primarily to ensure health and safety protection. Field screening for low-energy gamma radiation will also be conducted (Section 4.6.4) to locate any areas of elevated radionuclide concentrations.

At each selected location, a hollow-stem auger will be used to obtain continuous core to 5 ft (Procedure C-6, Appendix C). Five feet corresponds to the probable maximum depth of soil that could be disturbed through placement of utilities at some time in the future. (See the discussion of possible future uses of the site, Section 4.3.3.2.) Samples will be taken from three locations in each core: 0 to 12 in., 25 to 35 in., and 50 to 60 in. Analysis of samples from various depths is needed to determine if potential contaminants are vertically distributed near the firing sites. Samples will be appropriately containerized and submitted to an analytical laboratory for analysis for the potential contaminants of concern listed in Table 5-10.

5.3.5.1.2 Sampling in Area Surrounding Firing Points

The size of the area that is to be sampled surrounding the firing sites was established by considering data from existing firing sites. Sampling data from a nearby active firing site in TA-36 (Lower Slobbovia) indicate that both uranium and barium (an HE residue) concentrations decrease rapidly with distance from the firing point to approximately 200 ft, and then remain relatively constant out to

750 ft (the limit of the sampled region) (LANL 1989, 0425). The presence of radioactive or hazardous materials within OU 1093 (and possibly OU 1148) in the form of widely dispersed fragments from test shots can, therefore, be partly attributed to the active firing sites in TA-36. Evaluation of the extent and potential cleanup of these fragments will occur in the future as part of decontamination and decommissioning activities for these active firing sites. This situation justifies deferring action on any characterization or remediation efforts for widely scattered fragments potentially originating from the abandoned TA-27 firing sites.

Phase I sampling is therefore designed to detect disperse particulate contamination rather than to locate all possible shrapnel in the area and will thus address the area surrounding the firing sites with the greatest potential for particulate contamination. A circle, 500 ft in radius, surrounding each firing site can be expected to contain a significant portion of the small particulate soil contamination, with concentrations increasing toward the firing site.

The potential region to be sampled at SWMU 18-002(a) in Pajarito Canyon is, therefore, a circle 500 ft in diameter surrounding the single former firing chamber (Figure 5-15). For SWMU 18-002(b) in Threemile Canyon, the region to be sampled extends 500 ft up-canyon from the medium firing pad to 500 ft down-canyon from the firing chamber, TA-18-4 (Figure 5-15). The sampled region in TA-27 extends from 500 ft west of Firing Pit 1 to 500 ft east of Firing Pits 4 and 5 (Figure 5-16). Portions of these areas within the present security fenced area surrounding the two kivas (Buildings TA-18-23 and -32) were excluded from sampling. The areas inside the fence have experienced significant surface disturbance since the firing sites were active. At the time of site decommissioning, they will undergo additional disturbance, and sampling related to decommissioning activities. Sampling of the areas within the security fences would not provide useful or meaningful data for decisions regarding a need for remediation. (It should also be noted that such areas are potentially subject to contamination by continuing operations at the site and will be evaluated when the site is ultimately decommissioned or modified for a new use.) Similarly, locations overlying the Pajarito Road right-of-way through TA-27 and locations within the sewage lagoon area were not included in the sampling area. Locations on the nearly vertical walls of the canyons were eliminated from the pool of potential sampling locations because of the physical difficulty of sampling these areas. However, these locations are within the outermost portions of the candidate sampling area, where concentrations of potential contaminants are expected to be relatively low. Locations on top of the mesas near the canyons were also eliminated from Phase I sampling. These areas are at the outer edge of the sampling region (where concentrations are expected to be lowest) and, because of their elevation above the firing points, are much less likely to have received disperse particulate deposition of potential contaminants. Finally, locations within the stream channels near the three firing sites were eliminated because they will be addressed as part of the wetland sampling plan, Section 5.7, and by outfall sampling. This approach resulted in the areas indicated in Figures 5-15 and 5-16, within which sampling for disperse contamination will occur.

The potential variability in the concentrations of potential contaminants of concern in soils within the region to be sampled would suggest a relatively large number of locations for sampling. Such a large number would be justified if contamination was known (or even strongly suspected) to be present. However, the only information on current concentrations is at the firing sites themselves (Section 5.3.2.1.1), and that data only indicated that uranium was elevated 2 to 10 times above background. The reported values for uranium are less than values for screening action levels for uranium (Section 4.6). The proposed sampling was, therefore, designed only to provide preliminary information on the range of concentrations and the spatial distribution, rather than a detailed mapping. If any concentrations above screening action levels are observed in the Phase I sampling, a Phase II investigation will be considered.

The area to be sampled was divided into circular sectors, corresponding to distance intervals from the firing points (Figures 5-15 and 5-16). Eleven sampling locales were selected for each of the areas in TA-18 (Threemile and Pajarito canyons). This number of sampling locales should provide a 95% probability of detecting contamination affecting at least 25% of the area (Section 4.5.1.3). Because of the greater area and the number of firing sites, 14 sampling locales were selected in the former TA-27. This will provide a 95% probability of detecting contamination affecting at least 20% of the area Three distance intervals were selected around each former firing site: 0 to 100 ft, 100 to 300 ft, and 300 to 500 ft. Concentrations of potential contaminants of concern are likely to be highest in the inner zone and lowest in the outer. Approximately half of the sampling locales were selected in the inner circles, with decreasing fraction in the outer two. The result was a ratio of 5:3:3 for the TA-18 sites, and 7:4:3 at TA-27 for the 0 to 200 ft, 200 to 300 ft, and 300 to 500 ft circles, respectively. This stratification scheme increases the likelihood of detection near the firing sites, while providing some information changes in concentration with distance from the firing points. The total number of sampling locales in each of the three areas is sufficiently large to allow development of statistical parameters describing the observed soil concentrations, while not being excessive. The specific locales to be sampled, as illustrated in Figures 5-15 and 5-16, were selected to minimize possible interference from adjacent firing sites. For example, at TA-27, no locales were selected that lay within the 200-to-300-ft ring surrounding both of the two adjacent groups of firing sites.

At each locale selected for sampling, radiation surveys will be conducted at intervals of approximately 3 ft using a FIDLER (Section 4.6.4.1) along radial lines extending north, south, east, and west from a common center. Soil samples will be selected along the same lines at intervals of 5 and 10 ft and will be submitted to the mobile laboratory for analysis for metals and SVOCs. This field screening and mobile laboratory analysis will provide data on the possible presence of potential contaminants. For each locale, four locations will be selected for collection of samples to be submitted to an analytical laboratory. If elevated levels are detected in the field screening, these four locations will be included. If no elevated levels are detected, locations will be selected at approximately 10 feet from the common center, along the radial lines previously identified. Soil samples will be collected from the top 12 in. of soil at each of the four locations using a thin-wall sampler (SOP-06.19). The sampling depth of 12 in. was selected both to represent present surface conditions and to allow for some downward transport of potential contaminants by percolation. Metals (including radioactive elements) tend to be sorbed to soil particles and would generally be retained in the near-surface soil layers, except as removed by erosion (Section 4.3.1). Coarse material, over 0.5 in. in size, will be removed by screening, and the remaining material from the four locations will be composited by hand-mixing the material in a stainless steel bucket with a stainless steel trowel. (Metals and radionuclides are retained on finer-grained particles and those same fine-grained particles are the source of exposure.) The size fraction selected for sampling will be revised as necessary to correspond with assumptions presented in the risk assessment guidance in future revisions of the IWP. A single aliquot will be selected from each composite and submitted for analysis for contaminants of concern. (Note that sample compositing is not appropriate for VOCs; however, VOCs are not identified as potential contaminants of concern for the firing site areas.) The selection of four sampling locations for each locale enhances the possibility of detecting high concentrations of potential contaminants while not significantly increasing sampling costs.

For three locales at each of the three firing site areas (a total of nine), two cores will be taken at each of the four sampling locations and composited to two samples for each locale. This group of nine sets of two samples will provide a statistical measure of how well the compositing provides a measure of the average concentration at each locale.

The collected samples will be properly containerized and submitted to an analytical laboratory for analysis of the potential contaminants of concern, listed in Table 5-10. Analytical data will be evaluated to determine if concentrations above screening action levels were detected. If so, consideration will be given to performing a baseline risk assessment or Phase II sampling as necessary. If all observed concentrations are below screening action levels, the data will be evaluated for the statistical probability of there being other, unsampled locales above screening action levels. If that probability is less than the target of 95%, additional sampling will be proposed.

5.3.5.2 AOCs 18-005(a) Magazine and 18-011 Generator Building

Sampling will be conducted in the immediate vicinity of the former location of the magazine, AOC 18-005(a), and the former generator building, AOC 18-011 (Figures 1-2 and 5-5, respectively). Five equally spaced sampling locations will be selected around the perimeter of each of these two former buildings, within 2 to 3 ft of them. Locations close to the former buildings should contain the highest residual contamination, if any releases occurred from the buildings. Five sampling locations at each site will provide at least 95% confidence that contamination above the measured levels exists in no more than 50% of the sampled region (Section 4.5.1.3).

5.4 PRS Aggregate "D" for TA-18 - Storm Sewer Outfalls

The PRSs in this aggregate are all discharge points for storm sewers that drain roofs and paved areas in TA-18 (Figures 2-4, 2-5, 2-7, and 2-8). One of these, SWMU 18-010(f), also provides a discharge point for floor drains in Kiva 2.

5.4.1 Description and History

Storm sewer outfalls are associated with the main building complex at TA-18. The primary buildings served are TA-18-28, -30, -31, -37, and -147. These outfalls receive water from associated storm sewers and are not NPDES permitted because it is not presently required because no known or stated pollutants are introduced into them. The PRSs in this aggregate, together with brief descriptions and known or suspected contaminants as discussed in Chapter 2, are listed in Table 5-11. More detailed descriptions and histories follow.

Historically, much of the Laboratory allowed materials with a potential for producing environmental contamination (e.g., lead bricks or liquids in containers) to stand in the open air on the ground and/or on paved areas within each site. It is possible that contaminants from these sources could have found their way into streambeds through storm sewers by way of associated piping and outfalls. Visits to TA-18 in the summer of 1992 revealed that the site appeared to be clear of visible potentially contaminating waste materials. Inquiries with TA-18 personnel indicated that TA-18 has always been a clean site. Storage as indicated above was never seen, but there is no documentation to prove that radioactivity, lead, or toxic chemicals were not released to the storm sewers outfalls.

5.4.1.1 AOC 18-010(b) - Storm Sewer Outfall

The storm sewer discharging to this outfall is a drainage ditch that runs southward along the west side of the paved area west of Building TA-18-30. It outfalls into a flat grassy area at the fence southwest of the southwest corner of Building TA-18-30 (Figure-5-6). Because of the thick grass, it is difficult to determine how far the liquid flows before it completely infiltrates the ground. A label on a 1988 photograph (LANL 1988, 16-0053) of Building TA-18-110, adjacent to the drainage ditch, refers to a "refueling platform with indication of spillage into storm drainage ditch." Building TA-18-110 is presently a flammable storage locker.

TABLE 5-11

PRS AGGREGATE "D"
STORM SEWERS/OUTFALLS

PRS No.	PRS Title	Structure No.	Operational Status	Period Used	Suspected Contaminants
18-010(b)	Storm sewer outfall	NA	Active	?-present	U, Pb, solvents
18-010(c)	Storm sewer outfall	NA	Active	?-present	U, Pb, solvents
18-010(d)	Storm sewer outfall	NA	Active	?-present	U, Pb, solvents
18-010(e)	Storm sewer outfall	NA	Active	?-present	U, Pb, solvents
18-010(f)	Storm sewer outfall	NA	Active	?-present	U, Pb, solvents

5.4.1.2 AOC 18-010(c) - Storm Sewer Outfall

This is a storm drainage collection area that drains the paved area between Buildings TA-18-30 and -31. It outfalls to the southeast of Building TA-18-30 into a grassy depression. Because of the thick grass, it is difficult to determine how far the liquid flows before it infiltrates completely. The SWMU Report (LANL 1990, 0145) describes this outfall as being south of Building TA-18-30, but the map in the report indicates its location as being immediately adjacent to the building. Field inspection revealed that the area labeled on the map was actually a graveled area and that the discharge point for runoff from south of Building TA-18-30 and Building TA-18-31 was actually located as shown in Figure 5-6.

5.4.1.3 AOC 18-010(d) - Storm Sewer Outfall

This storm drainage collection area, northeast of Building TA-18-37, drains the paved area northeast of Building TA-18-37. It outfalls at the northwest corner of Building TA-18-258 (Figure 5-5) into a flat graveled and grassy area. It is reasonable to assume, because of the flatness of the area and the amount of gravel, that infiltration of storm water is almost immediate.

5.4.1.4 AOC 18-010(e) - Storm Sewer Outfall

This storm sewer drains the paved area between Buildings TA-18-28 and -147. It enters a drain at the east end of the buildings, passes under the paved area west of Building TA-18-129 to a grating east of Building TA-18-190, and outfalls to the south at the fence next to the driveway (Figure 5-5). The outfall area is a grassy gully that leads toward the main drainage flowing eastward in Pajarito Canyon. Because of the thick grass, it is difficult to determine how far the liquid flows before it infiltrates completely.

5.4.1.5 AOC 18-010(f) - Storm Sewer Outfall

A storm sewer drains the roof and floor drains of Kiva 2. It outfalls to the north of the northeast corner of Kiva 2 (Figure 5-3), then exits from a sandy and grassy bank on the south side of the stream channel in Threemile Canyon. Because of the sandy and grassy nature of the terrain, the liquid infiltrates into the soil within 5 to 10 ft.

5.4.2 Conceptual Exposure Model

Use of screening action levels assumes that exposure occurs at the present location of the contamination. The primary potentially contaminated media are stream channel sediments in Pajarito Canyon, which receive the discharge from all outfalls in this aggregate.

5.4.2.1 Existing Information on the Nature and Extent of Contamination

No data have been collected at present. Potential contaminants, as listed in Table 5-11, consist of materials that may have been previously stored on paved areas. Although solvents were reported as potential contaminants (several years in the past), dilution by runoff and aeration of sediments will have volatilized these compounds and they are not expected to be present in outfall areas, even if they had been released from container storage areas at TA-18.

5.4.2.2 Potential Pathways for Contaminant Migration

As illustrated in Figure 4-3, streamflow, with associated transport of channel sediments, is the primary migration pathway for this aggregate.

5.4.3 Remediation Alternatives and Evaluation Criteria

5.4.3.1 Soil Excavation and Treatment or Disposal

These storm sewer systems will remain in use until site decommissioning. If any surfaces within the drainage system at or below the outfalls are shown to be contaminated above screening action levels, a Phase II investigation may be conducted, leading to a baseline risk assessment, to better define the extent of contamination and its significance. Remediation, if required, would consist of removal of contaminated soil around the drain lines and ditches at outfalls or within stream channels for treatment and/or appropriate disposal. Therefore, Phase I data will be collected to establish the levels of contamination within these areas.

If site characterization samples indicate no contamination of media above screening action levels around the drain lines, outfalls, or in channel sediments, NFA will be proposed for the respective PRSs.

5.4.4 Data Needs and Data Quality Objectives

The only data that will be collected during Phase I investigations are those required to assess potential containment source areas. Sufficient knowledge exists regarding potential environmental transport processes to design these investigations. If Phase II investigations are required, further investigation of environmental processes may be included.

5.4.4.1 Data for Evaluation of Health and Safety Risks

Phase I data will be collected to establish the concentrations of contaminants of concern, as listed in Table 5-11, in environmental media affected by each AOC. Very little information exists on actual waste discharges to these AOCs. Thus, the potential contaminants of concern have been identified based on knowledge of materials potentially stored in areas drained by these outfalls. As previously stated, the measured concentrations will be compared with screening action levels to establish the need for further investigation or to propose NFA. Thus, the sample collection and analysis must result in contaminant detection limits that are at or below the screening action levels.

The data must be statistically representative of the sampled region. All sampling will be judgmentally focused on the most probable location of contamination (drainages, outfalls, and stream channel). Because of the number of outfalls in both this aggregate and in Aggregate A (Liquid Waste Management Systems), it is probable that any observed contamination in channel sediments will not be traceable to a single source. Further, because of the active nature of the stream channel, redistribution of sediments is likely to have occurred. A primary objective of sediment sampling for this aggregate will be to establish whether contaminant concentrations are above or below screening action levels throughout the portion of the channel affected by these outfalls. A probability of 95% of detecting contamination in at least 50% of the channel near the outfalls is considered appropriate for this determination. Further sampling of sediments in downstream areas is proposed in wetlands (Section 5.7) and will also be included in investigations conducted by the Canyons Operable Unit. If Phase II investigations are required, the spatial variability observed in Phase I sampling will be included in the design of that sampling. Quality control samples (splits, duplicates, equipment blanks, and transportation blanks) will also be collected, as discussed in Annex II, Quality Assurance Project Plan.

Specific data requirements include the contamination types and concentrations present in drainage-ways, around outfalls, and in channel sediments below outfalls.

5.4.4.2 Environmental Setting

No data are needed for Phase I decisions. If contamination above screening action levels is present in soil or sediments, Phase II investigations may require data to characterize environmental migration pathways.

5.4.4.3 Potential Receptors

Phase I data will be compared with screening action levels, so no potential receptors need to be identified. If Phase II investigations are required, actual potential receptors will be considered in the design of those investigations.

5.4.5 Sampling Plans

5.4.5.1 AOCs 18-010(b), (c), (d), (e), and (f)

Proposed sampling for this aggregate is presented in Table 5-12, and sampling locations are shown in Figures 5-11, -12, -13, and -14. No VCAs are planned as part of Phase I investigations for this aggregate.

TABLE 5-12

SAMPLING PLAN FOR PRS AGGREGATE D, STORM SEWER OUTFALLS

PRS Number	PRS Description	Sample Description	Field Survey				Mobile Lab.				Analytical Laboratory													
			Location survey	Geophysical survey	Rad screening (α, β, γ)	VOC screening	No. of sampling locations	Metals	VOCs	SVOCs	No. of sampling locations	Mob. lab. rad. screening (α, β, γ)	VOCs (EPA 8240)	SVOCs (EPA 8270)	Metals (EPA 6010)	HE (USATHMA[a])	General mineral (std. methods)	Chloride—soils (EPA 300)	Nitrate—soils (EPA 300)	Uranium (total) (DOE[d])	Plutonium (isotopic) (DOE[d])	Thorium (isotopic) (DOE[d])	Gamma spectroscopy (DOE[d])	BTEX (EPA 8020)
18-010(b)	Outfall and ditch																							
		Sediments			X		14	X		X	7	X		X	X					X			e	
18-010(c)	Outfall																							
		Sediments			X		4	X		X	2	X		X	X					X			e	
18-010(d)	Outfall																							
		Sediments			X		4	X		X	2	X		X	X					X			e	
18-010(e)	Outfall																							
		Sediments			X		14	X		X	7	X		X	X					X			e	
18-010(f)	Outfall																							
		Sediments			X		4	X		X	2	X		X	X					X			e	
QC samples																								
		Sediments—duplicates			X						2	X		X	X					X			e	
		Rinsate blanks			X						2	X		X	X					X			e	

a. US Army Toxic and Hazardous Materials Agency, no date, 0522.
b. Maximum number, assuming all sampled locations show contamination.
c. Geophysical surveys may be used to locate drain fields if technology is proven by ongoing RFIs.
d. HASL-300 (DOE 1983, 0516).
e. Only when gross-gamma is above background.

Two samples will be collected at each outfall. One will be from the first sediment trap downstream from the outfall, if one is available within 5 ft of the end of the pipe; if it is not, a soil sample will be collected within 2 ft of the pipe. The second sample will be collected between 5 and 20 ft below the pipe, depending on the availability of a suitable sediment trap. These samples are intended only to sample the most probable locations of any potential contaminants in the outfall area. For the open ditches associated with SWMU 18-010(b), five locations will be selected within the length of the ditch. Samples will be from sediment traps, or will be equally spaced throughout the length of the ditch if no preferential locations are apparent. Based on sampling statistics as discussed in Section 4.5.1.3, five samples will result in a 95% probability of detecting contamination in at least 50% of the ditch.

Five sampling locations will be selected in the main stream channel downstream from the easternmost outfall [AOC 18-010(e)], between the location where discharges from that outfall reach the channel and Potrillo Drive (Figure 1-2). These sampling locations are intended to detect the integrated effects of all outfalls on the stream sediments in TA-18, in the channel between the eastern boundary of TA-18 and the easternmost outfall.

A potential exists that contaminants discharged from outfalls at TA-18 may also have been discharged from upstream technical areas. Should concentrations of potential contaminants of concern above screening action levels be observed, Phase II investigations, if required, will include determination of the actual source of these contaminants.

Before sampling, candidate locations will be surveyed for radioactivity (Section 4.6.4.1) and field screened for metals and SVOCs (Section 4.6.4.2). This screening will be used to select final sampling locations. At each selected sampling location, sediment samples will be collected to a depth of 6 in. using a spade and scoop sampling procedure (SOP-06.09). All samples will be screened for radionuclides using Procedures C-4 and C-3, Appendix C, and sent to an analytical laboratory for analysis as presented in Table 5-12. Although solvents are identified in Table 5-11, this sampling plan does not include any analysis for VOCs. Runoff and sediment transport would result in volatilization of any VOCs released historically, and solvents would not be retained in surface sediments. All potential releases are in the nature of low-volume spills; no high-volume releases have been reported or are suspected. In addition, no potential source of solvent release to the storm sewer system has existed for several years. SVOCs, if present in the sediment, could be at least potentially preserved, and an analysis will be done. Sediments, surface water, and groundwater from wetland areas downstream from TA-18 will be analyzed for both VOCs and SVOCs (Section 5.7)

5.5 PRS Aggregate "E" for TAs-18 and -27 - Burial Trench, Bazooka Impact Area, and Buried Military Tank

These PRSs were aggregated because of the similarity in the hazards they pose and the similarity of methods that will be used to investigate them. Both the SWMUs in this aggregate involve the burial or subsurface presence of material that is primarily a potential safety hazard if inadvertently exposed by human or animal intrusion (Table 5-13). (Radioactive material may be present at two of the release sites.)

5.5.1 Description and History

5.5.1.1 SWMU 27-001 - Burial Trench

It is suspected that around 1945 a trench was dug near the base of the south-facing cliff, east of TA-18, for the burial of one or more US Navy guns used in onsite experiments (LANL 1990, 0145). These were 6- to 8-in. bore guns such as those with which cruisers and battleships are equipped. Uranium and some unused ordnance are suspected contaminants. Contradicting information regarding the location of this burial trench makes it difficult to verify a location. While a 1964 Laboratory memo (Russo 1964, 16-0054) indicates one location of a burial trench, 1992 interviews (REF. _____) with site personnel indicate other locations (Figure 1-2). A 1992 site visit revealed aligned gravel patches in one suspected location of the trench; however, excavations for road construction material between 1949 and 1962 make these present surface indications unreliable. Aerial photographs reveal lineations that could be burial locations at the other two suspected areas.

5.5.1.2 SWMU 27-003 - Bazooka Impact Area

The bazooka firing site for SWMU 27-003 was on the south side of the present location of Pajarito Road; the impact area was on the north side of Pajarito Road on or near the south-facing cliffs in Pajarito Canyon (Figure 1-4). The bazooka impact area was used from 1944 until 1947. (The SWMU Report [LANL 1990, 0145] mistakenly identified this as a mortar impact area.) This location appears to be the same as SWMU 36-009 (assigned to OU 1130), because the SWMU Report refers to both SWMUs 27-003 and 36-009 as "mortar" impact areas. The indicated locations of the two SWMUs are near one another, but only one such impact area is known to exist in Pajarito Canyon. (The description of SWMU 36-009 indicates that the exact location of the site is unknown.) The site has been cleaned of unexploded ordnance and other residuals numerous times by the US Army (Drake and Courtright 1966, 16-0055; Drake and Courtright 1966, 16-0056); however, the site remains fenced off because there is still the potential for some unexploded ordnance to remain buried in talus on the hillside or on the mesa top. A program to periodically sweep all munitions impact areas was conducted in the 1960s through the 1980s to retrieve residuals. Any remaining residuals would be subsurface.

5.5.1.3 SWMU 18-007 - Buried Military Tank

The SWMU Report (LANL 1990, 0145) cites a Laboratory memo indicating that a Laboratory employee remembers burying a "tank" in Threemile Canyon, west of Kiva 2 (Figure 1-2). An unsuccessful attempt was made to locate the memo referenced in the SWMU Report. One of the initial investigators for the CEARP Report (DOE 1987, 0264) remembers that, during the course of his interviews,

TABLE 5-13

PRS AGGREGATE "E"—MATERIALS DISPOSAL AREAS AND BAZOOKA IMPACT AREA

PRS No.	PRS Title	Structure No.	Operational Status	Period Used	Suspected Contaminants
18-007	Buried military tank	NA	Inactive	~1949	Unknown
27-001	Burial trench	NA	Inactive	~1945	U, munitions
27-003	Bazooka impact area	NA	Inactive	~1944–1947	Munitions

the buried "tank" was understood to be a "military tank." However, the CEARP and SWMU reports mention only that an employee remembers burying a tank in this suspected site. According to both reports, the tank is buried approximately 1.25 miles west of Kiva 2. No evidence to confirm this burial could be obtained. No individuals present at the place and probable time of burial (about 1944) could be located. The suspected buried tank, if originally present at the site, would have belonged to the US Army, which was posted at the site in the early 1940s. Based on archival review, no evidence was found that such a tank was used in any of the experiments at the site.

5.5.2 Conceptual Model

A pathways model for the SWMUs in this aggregate is presented in Figure 4-3. The primary concern with both these sites is the potential for human intrusion, leading either to a safety concern, if any unexploded ordnance is present, or to residual contamination in the case of SWMU 27-001.

5.5.2.1 Existing Information on the Nature and Extent of Contamination

No information is available to document the existence of radioactive or hazardous waste releases from these SWMUs. As noted in Section 5.5.1.1, uranium was reportedly present in the burial trench (SWMU 27-001).

5.5.2.2 Potential Pathways for Contaminant Migration

The pathways model, Figure 4-3, indicates that human (or animal) intrusion and percolation are the two primary migration pathways. Percolation of rainwater or snowmelt, with attendant leaching of contaminants, is a potential pathway for groundwater contamination. Such a pathway will be considered in the event a Phase II investigation is required. Phase I will only be concerned with locating the position of any buried or subsurface material.

5.5.3 Remediation Alternatives and Evaluation Criteria

If the burial site is located, the buried material can be removed from the trench and disposed of properly. Similarly, any metallic items in the bazooka impact area can be unearthed and disposed of as appropriate. These removals would require skilled and experienced ordnance disposal personnel because of the potential safety hazards associated with the suspected buried or subsurface items. If locating the burial site or detecting subsurface metallic items at the bazooka impact area is unsuccessful, NFA will be proposed for these SWMUs.

5.5.3.1 Data for Evaluation of Health and Safety Risks

The objective of Phase I investigations for this aggregate will be to confirm or refute the presence of metallic items in the subsurface at the reported burial sites or at the bazooka impact area. Because of the potential safety hazards, no sampling will be conducted in Phase I. Should metallic items be detected, a Phase II investigation will be proposed to excavate and/or characterize the subsurface material.

5.5.4 Environmental Setting

No additional environmental data are needed for Phase I decisions.

5.5.5 Sampling Plans for Geophysical Surveys

Phase I investigations will use geophysical surveys (Section 4.5.1.2) to locate the position of any subsurface metallic items at the SWMUs in this aggregate.

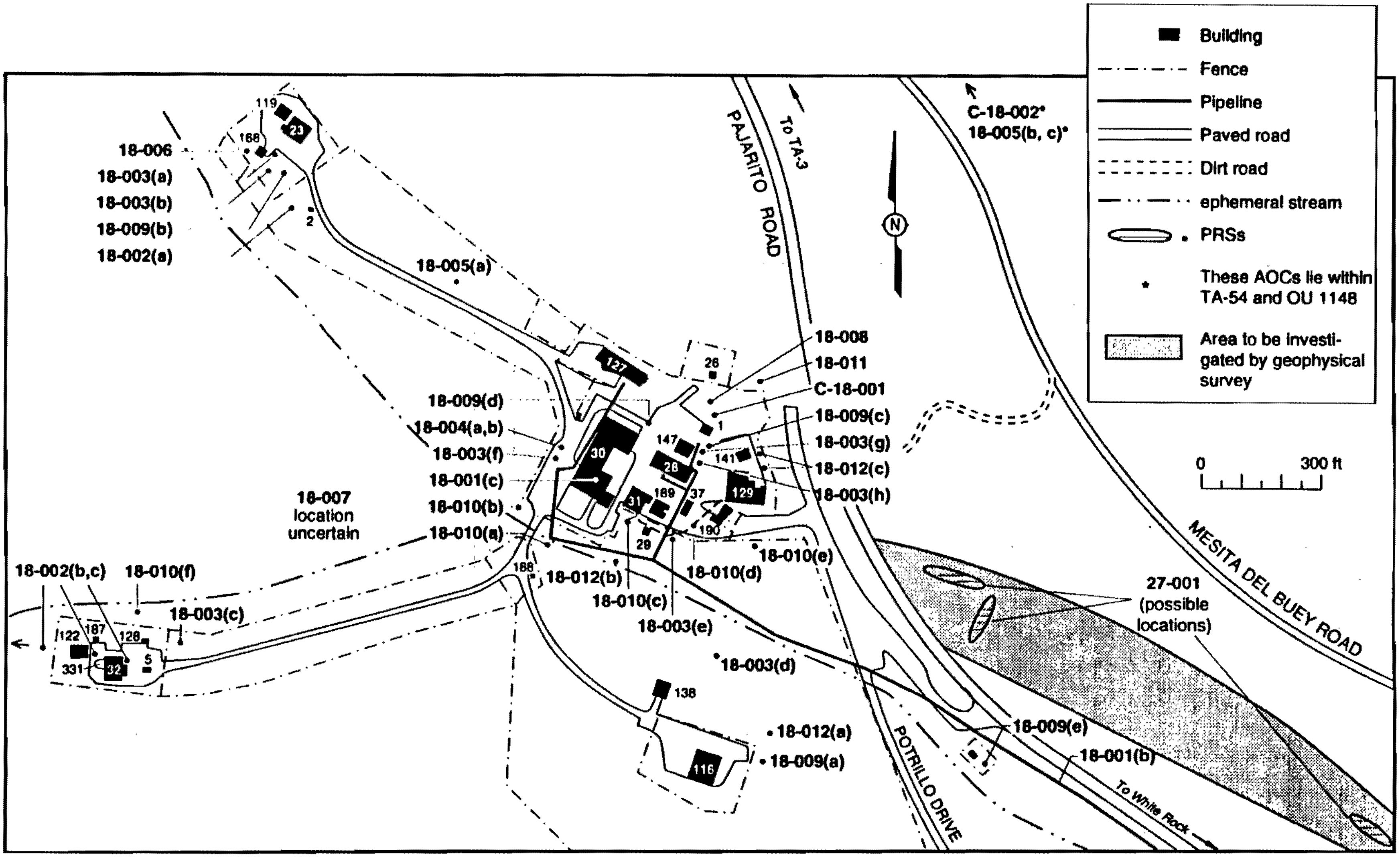
Before performing the geophysical surveys, a grid system will be constructed throughout the geophysical investigation area. The extent of the area to be investigated is illustrated in Figures 5-17, -18, and -19. Grid markers, consisting of wooden lath and flagging, will be emplaced at the appropriate grid intervals and marked with grid coordinates. The grid system will be used to locate geophysical traverses and locate measurements along each traverse. The results of the geophysical surveys will be referenced to the grid system for each area of investigation. The surveys will be designed to locate large metallic items at burial depths of up to 15 ft for SWMUs 18-007 and 27-001, and to locate small (1- to 3-in.-diameter by 12- to 18-in.-long) metallic items at depths up to 3 ft for the bazooka impact area (SWMU 27-003). No other sampling or analysis is planned for Phase I investigations in this aggregate.

5.5.5.1 SWMU 27-001 - Burial Trench

A magnetometer survey will be employed to assess the location of possible buried US Navy guns at SWMU 27-001. Several large naval guns are potentially buried in a trench or trenches at a depth of approximately 15 ft. Magnetometer measurements will be obtained from an approximately 12.5 by 12.5 ft grid system throughout the geophysical investigation area. Total magnetic field and vertical magnetic gradient values will be collected simultaneously at each measurement location.

A GEM GSM-19 magnetometer (or similar instrument) will be used to obtain the magnetic data. Magnetometer measurements and associated survey grid information will be stored in the instrument's memory during field operations. The information will be downloaded to a personal computer at the end of each field day. During the field survey, the locations of any surface structures or debris will be noted.

After completion of the field survey, computer-generated contour maps of both total magnetic field and vertical magnetic gradient values will be constructed. These maps will be inspected for the location of anomalous magnetometer measurements (anomalies) that are typical of large buried metallic objects. The locations of these anomalies will be noted and referenced to the grid system. The anomalous locations will be compared with the locations of previously noted



Source: LANL, 1989, ENG-R5112, Sh.1

Figure 5-17. Area to be investigated by geophysical survey near SWMU 27-001.

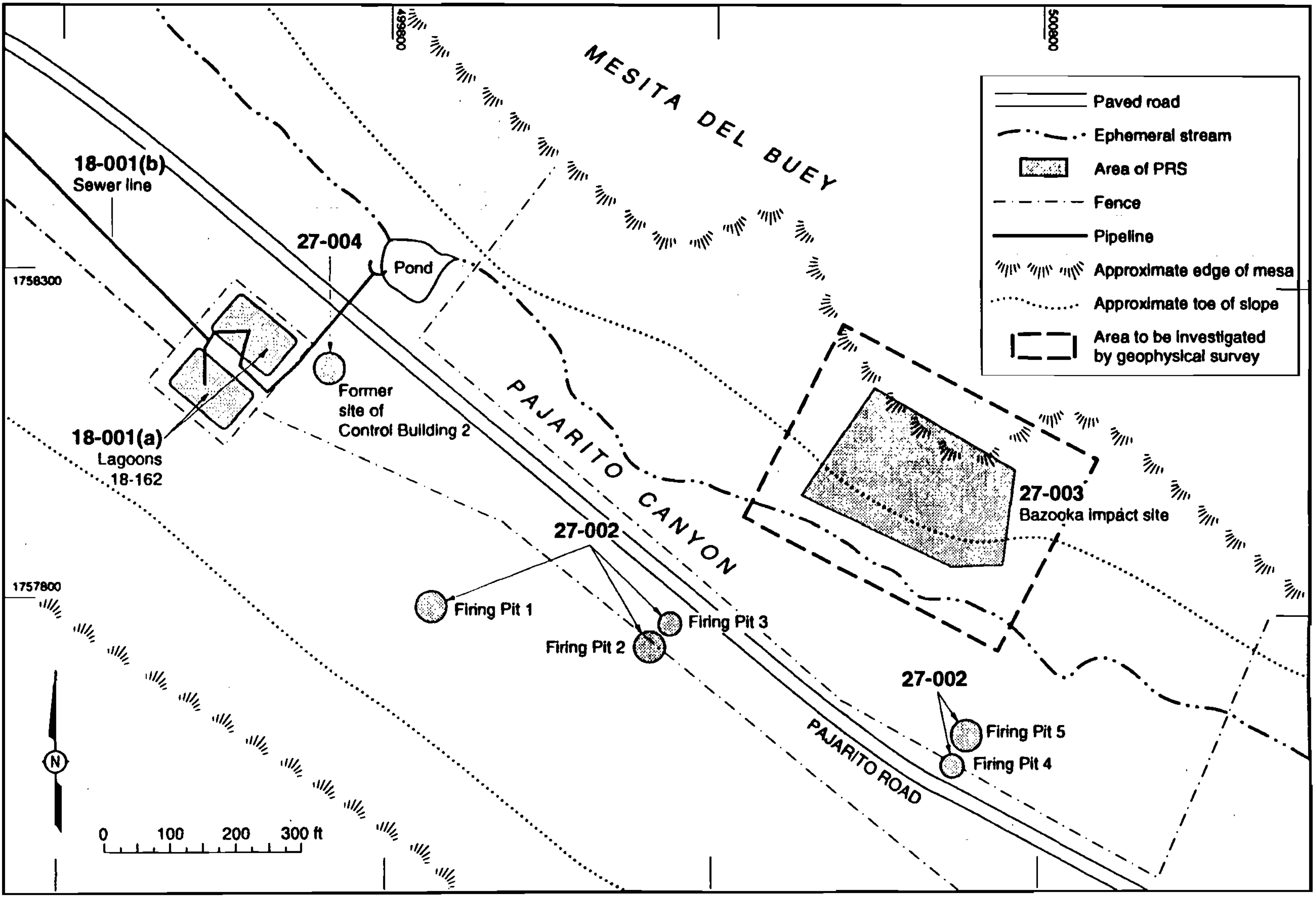


Figure 5-18. Area to be investigated by geophysical survey near SWMU 27-003.

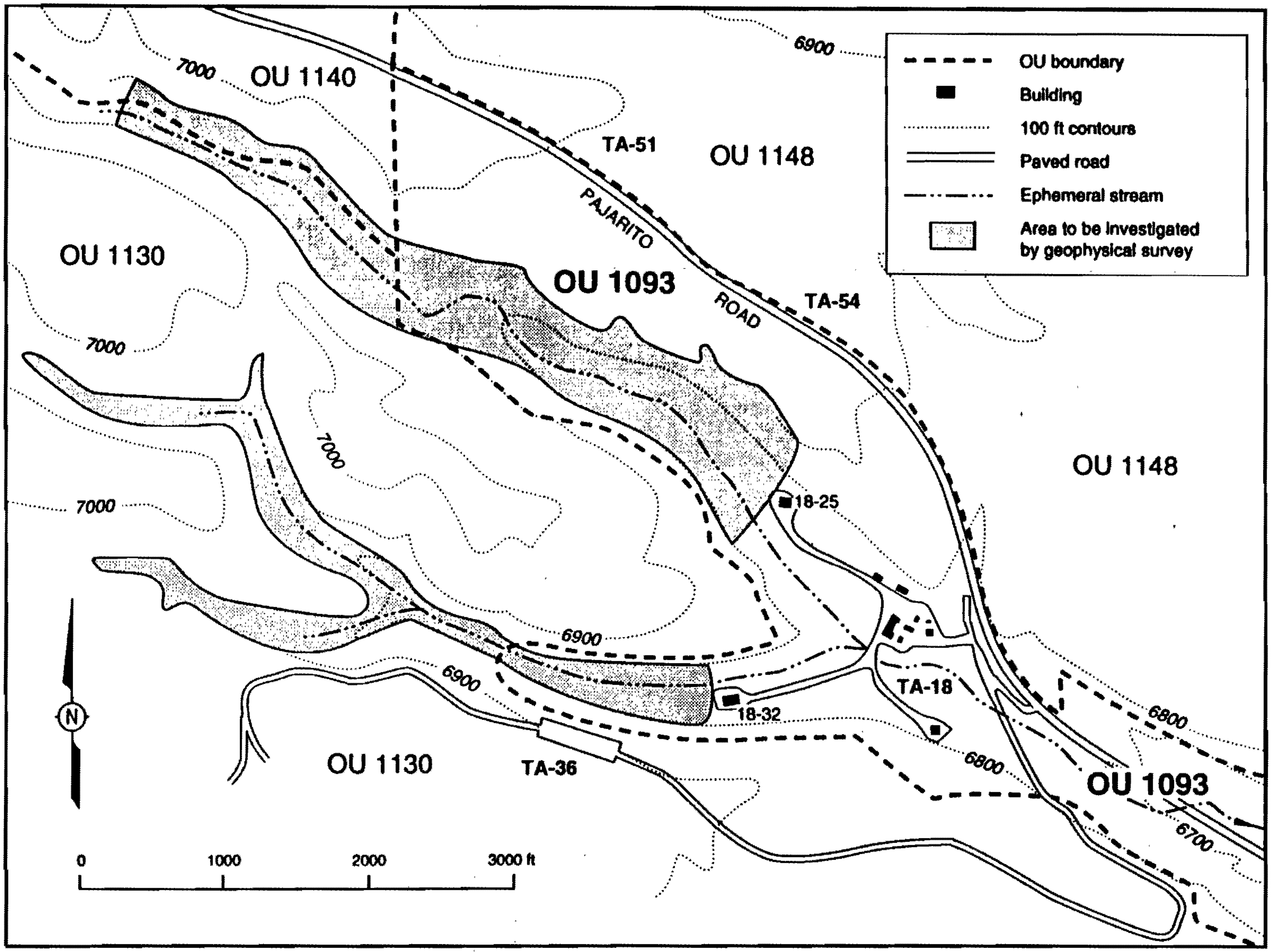


Figure 5-19. Area to be investigated for SWMU 18-007.

surface structures or debris. Anomalies that are not associated with surface features are interpreted to be caused by buried metal sources. The magnitude of the anomalies will be assessed to determine if they are in the range expected for buried naval guns.

An approximation of burial depth may be required for determining excavation efforts. A GPR survey may be successful at assessing the burial depth. GPR traverses can be performed over the location of target anomalies detected in the magnetometer investigation. GPR traverses should be performed using a number of GPR antennas consisting of various frequencies. The investigation depth of a GPR system is dependent on the electrical conductivity of shallow subsurface materials. Conductivity measurements can be made before the GPR survey. This information can be used for GPR survey design and estimates of the investigation depth.

5.5.5.2 SWMU 27-003 - Bazooka Impact Area

A magnetometer survey will be employed to assess the location of buried small metallic debris at SWMU 27-003. The purpose of the survey is to assess the location of buried unexploded ordnance that potentially exists within the geophysical investigation area. The ordnance is estimated to be approximately 1 in. in diameter by 12 in. long and buried at depths up to 3 ft.

Magnetometer data will be obtained from a 7.5 by 7.5 ft grid system throughout the geophysical investigation area. Total magnetic field and vertical magnetic gradient values will be collected simultaneously at each measurement location.

A GEM GSM-19 magnetometer (or similar instrument) will be used to obtain the magnetic data. Magnetometer measurements and associated survey grid information will be stored in the instrument's memory during field operations. The information will be downloaded to a personal computer at the end of each field day. The locations of any surface structures or debris will be noted in a field notebook during the field survey.

After completion of the field survey, computer-generated contour maps of both total magnetic field and vertical magnetic gradient values will be constructed. These maps will be inspected for the location of anomalous magnetometer measurements (anomalies) that are typical of buried metallic objects. The locations of these anomalies will be noted and referenced to the grid system. The anomalous locations will be compared with the locations of previously noted surface structures or debris. Anomalies that are not associated with surface features are interpreted to be caused by buried sources and may represent buried unexploded ordnance.

5.5.5.3 SWMU 18-007 - Burial Site

A reconnaissance electromagnetic survey will be performed in Threemile and Pajarito canyons in an attempt to locate the military tank rumored to be buried there. The area of investigation is large (one area, in Threemile Canyon, is approximately 1 mile long and about 600 ft wide; another area, in Pajarito

Canyon, is 1.25 miles by 500 to 1,000 ft wide). One investigation will take place on the floor of Threemile Canyon from the perimeter fence of Kiva 2 (TA-18-32), extending approximately 1 mile to the west. The search area was restricted to 1 mile because the steep terrain and narrowness of the upper end of the canyon discount the likelihood that anything as large as a tank is buried there. The other investigation will be conducted on the floor of Pajarito Canyon, beginning at the perimeter fence of Kiva 1 (TA-18-23) and extending 1.25 miles to the west. The recollection of the original investigator is that the burial was reported to be within 1.25 miles of the kiva; however, both canyons must be searched because of uncertainty as to which canyon was being referred to. To optimize the effort, traverses will be widely spaced (100 ft) at the beginning of the survey and fill-in traverses will be performed as required after inspecting the data every few traverses. Widely spaced grid markers will be emplaced across the width of the investigation area to site each traverse, and electromagnetic traverses will be performed parallel to the length of the investigation area.

Both components of the electromagnetic measurements (terrain conductivity values and in-phase values) will be simultaneously and automatically obtained at timed intervals along each electromagnetic traverse. Data will be collected every few seconds along each traverse and stored on a data logger. The data will be downloaded to a field computer after every two to four traverses, and computer-generated profiles of the data will be produced. The profiles will be inspected for anomalies that are typical of a large amount of buried metal (military tank). Fill-in traverses will be performed to better define any electromagnetic anomalies encountered after a given set of electromagnetic traverses. If no electromagnetic anomalies are encountered after a given set of traverses, fill-in traverses will continue to be performed. This will be repeated until an electromagnetic anomaly likely to be a buried military tank is encountered or until appropriate data coverage is achieved.

To perform the electromagnetic survey, a Geonics Ltd EM-31DL Terrain Conductivity Meter will be used in vertical dipole mode. Both components of the electromagnetic data and distance information along each traverse will be stored on an Omnidata data logger. Computer software to download and process the data is supplied by Geonics. Under optimum conditions, the investigation depth of this system is approximately 20 ft.

5.6 Groundwater Sampling

The shallow groundwater body in Pajarito Canyon extends from approximately 1 mile west of TA-18 to the vicinity of State Road 4 (Figure 5-20). Current and past activities within OU 1093 could have introduced contaminants into that groundwater. Some groundwater sampling is proposed in this chapter specific to individual release sites (Sections 5.1.5.1 and 5.1.5.2). Additional sampling is proposed in this section to augment that site-specific data.

5.6.1 Description of Existing Monitoring Wells

Several monitoring wells have been completed into the shallow groundwater body in the vicinity of TA-18. A significant volume of water quality data has been collected from these wells. Additional sampling will be conducted at these wells as part of Phase I sampling to further evaluate whether Laboratory activities have impacted this shallow groundwater system.

5.6.1.1 PCO Series Wells

In April 1985, the Laboratory installed three observation wells, PCO-1, PCO-2, and PCO-3, into the shallow alluvial groundwater body in Pajarito Canyon. PCO-1 is approximately 1,200 ft south and east (downgradient) of the main area at TA-18. PCO-2 is directly downgradient from the two sewage lagoons in former TA-27. PCO-3 is approximately 2,500 ft northwest of the Laboratory's eastern boundary near the junction of Pajarito Road and State Road 4. All three wells are near or within the ephemeral streambed along the canyon floor (Figure 5-20) (Devaurs 1985, 0046).

The observation wells were drilled through the alluvium into the underlying tuff using a truck-mounted drilling rig equipped with a 7-in. auger. The boreholes were cased using 4-in. diameter polyvinyl chloride casing and were screened with perforated stainless steel. The wells were screened over the entire saturated interval. The annular space around the well casing was packed with gravel to within 2 ft of the ground surface and finished to the ground surface with concrete. Each well was fitted with a steel locking cap. Well development was performed by water jetting and pumping with a centrifugal pump. All three wells intersected perched water (Devaurs 1985, 0046).

The alluvium encountered in PCO-1 and PCO-2 consisted of light brown gravels, cobbles, and boulders intermixed with clays, silts, and sands. The tuff was light reddish brown, non- to moderately welded, and contained quartz and sanidine crystals and crystal fragments. A few small rock fragments were also observed. The alluvium/tuff interface occurred at a depth of 11 ft in PCO-1, and at a depth of 9 ft in PCO-2. Both wells were drilled to a total depth of 22 ft. In May 1985, the static water level was at a depth of 1.12 ft (land surface datum) in PCO-1, and 3.25 ft in PCO-2 (Devaurs 1985, 0046).

The alluvium in PCO-3 consisted of light brown gravels and infrequent cobbles in a silty sand matrix. The tuff was weathered, light grey to light brown, and contained minor quartz and sanidine crystals and fragments. A few small rock fragments in a matrix of silts and clays also occurred in the profile. The alluvium/tuff interface was observed at a depth of 12 ft and the well was drilled to a total depth of 20 ft. The static water level was at a depth of 1.71 ft in May 1985 (Devaurs 1985, 0046).

The PCO-series wells have been monitored annually since their completion as part of the Laboratory's Environmental Surveillance program.

5.6.1.2 LACEF Wells

During 1990, the Laboratory installed four monitoring wells, MW-1 (upgradient), MW-2, MW-3, and MW-4 (all downgradient), around the LACEF at TA-18 (Figure 5-7). These wells were installed to establish baseline levels of

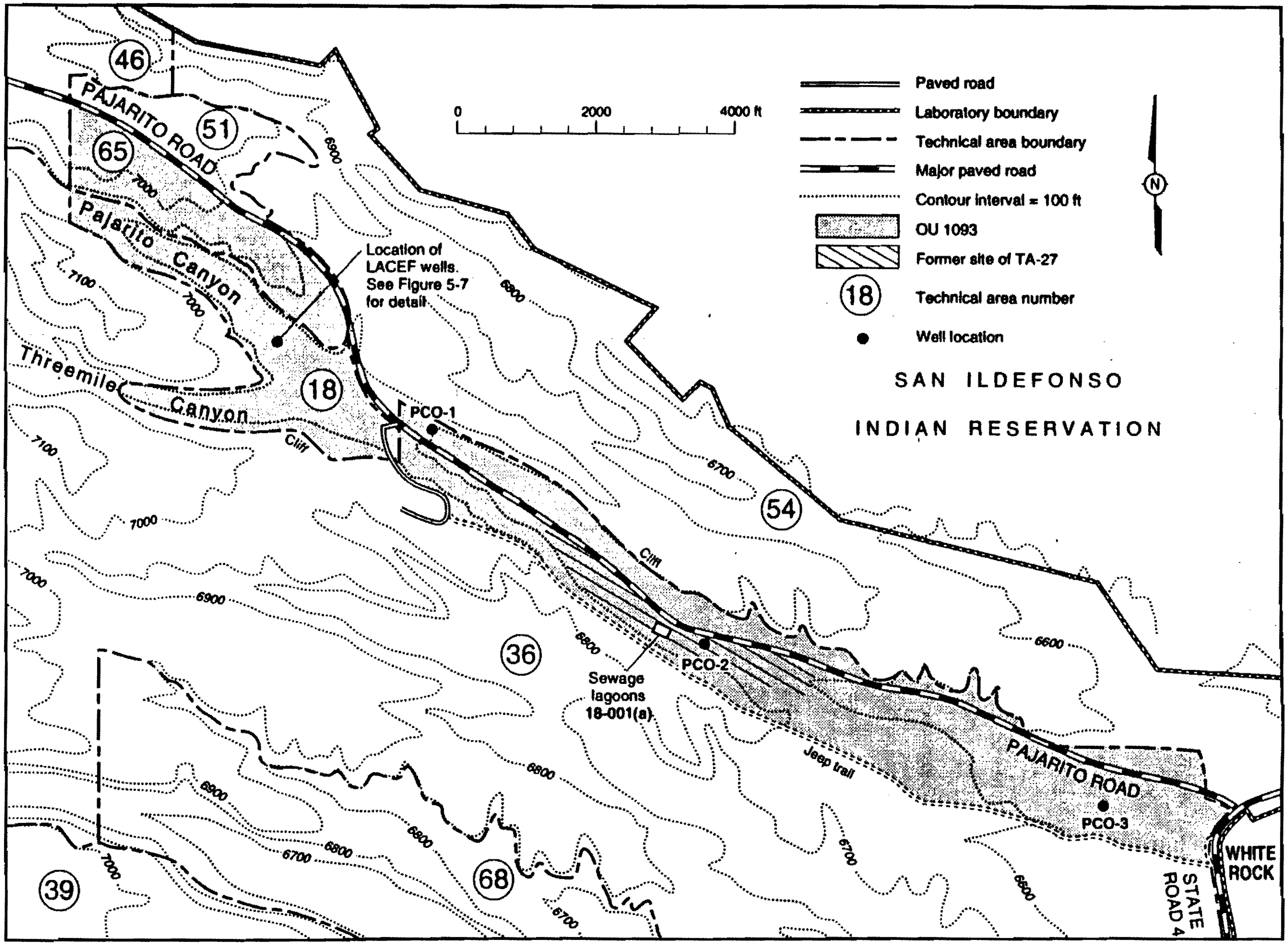


Figure 5-20. Location of existing shallow monitoring wells.

radionuclides in soils and shallow groundwater surrounding the LACEF and to assess the potential for transport of radionuclides in the shallow groundwater system in Pajarito Canyon (LATA 1991, 16-0005).

MW-1 is approximately 40 ft northwest of the LACEF; MW-2 is approximately 14 ft south of the building; MW-3 is approximately 21 ft southeast of the LACEF; and MW-4 is approximately 18 ft southeast of the facility and 17 ft northeast of MW-3 (Figure 5-7) (LATA 1991, 16-0005).

All four wells were drilled through alluvium to a depth of 25 ft. Drilling was performed with a top drive drill rig and an 8-in. hollow-stem auger. The wells were cased with a 20 ft section of 2-in. PVC well screen placed on the bottom of the borehole. Two-inch PVC casing was used from the top of the screened section to the ground surface. The annular space surrounding the well was filled with silica sand to within 3 ft of the surface and finished to the surface with grout. A metal well head with a cast iron cover was placed into the wet grout. A 2.5 ft diameter concrete collar and lockable expansion-type well plug were installed around each well for well head protection. The wells were developed by pumping with a hand pump (LATA 1991, 16-0005).

All four boreholes were split-spoon sampled every 5 ft during drilling. The alluvium encountered in the boreholes was similar in each one and consisted of a mixture of reddish brown sandy clays, clays, sands, and clayey sands. Tuff cobbles were common throughout the profile and were most frequently rounded to subrounded. Clay and sand layers of 1 in. to over 1 ft were common, with sandy layers ranging from poorly sorted to well sorted. No clear marker beds were identified in the boreholes, and most strata appear to be laterally discontinuous (LATA 1991, 16-0005).

None of the boreholes fully penetrated the alluvium; field observations indicate that the alluvium/tuff interface is probably at a depth of 35 ft in the area. The first indications of moisture were observed at a depth of 10 to 12 ft in each well, with the first fully saturated zones occurring at approximately 20 ft. Following well development, the static water level in the wells averaged approximately 15 ft (land surface datum). This is consistent with observations of construction activities in the area, where water has been encountered in excavations at approximately 15 ft of depth; however, water levels are highly variable both seasonally and annually in Pajarito Canyon (LATA 1991, 16-0005).

5.6.2 Existing Water Quality Data

Radiochemical data collected to date from the PCO-series wells indicate that Laboratory operations have had no impacts on the shallow groundwater system in Pajarito Canyon. The chemical data collected from these wells indicate that the shallow groundwater body in Pajarito Canyon could be used as a potable water supply. The chemical quality of water has varied slightly, but fluctuations are believed to be due to seasonal effects and are unlikely to be a result of Laboratory operations (Environmental Protection Group 1992, 0740). None of the water samples has exceeded the limits of quantification (LOQ) for organic compounds, with the exception of one sample collected from PCO-2 during 1989. This sample showed a concentration of 20 μg/L for the volatile compound carbon disulfide. The LOQ for carbon disulfide is 10 µg/L (Environmental Protection Group 1992, 0497). Detailed annual data for radiochemical, water quality, and organic constituents are presented in the Laboratory's Environmental Surveillance reports, beginning in 1985.

Water samples were collected from MW-1, MW-2, MW-3, and MW-4 following well construction and were analyzed for tritium, isotopic uranium, cesium, and strontium. All sample concentrations were below detection limits (Section 5.1.2.1.2) (LATA 1991, 16-0005).

5.6.3 Data Needs and Data Quality Objectives

The three existing wells downstream from TA-18 are strategically located to monitor potential impacts on water quality from operations within TA-18 (PCO-1), past operation of the sewage lagoons (PCO-2), and the overall combined effects of the entire operable unit (PCO-3) (Figure 5-20). Water quality data from these wells, as presented in Section 5.6.2, indicate that all measured parameters were at or below established screening action levels. These data are collected annually by the Laboratory in accordance with an established quality assurance program and are considered reliable. However, not all potential contaminants of concern are included in the existing data, and the possibility of seasonal variability cannot be assessed. It is desirable to have data collected by the ER Program in accordance with its quality assurance program.

Throughout the length of Pajarito Canyon, surface water is present only intermittently. Some areas of standing water, such as in wetland areas, probably reflect the elevation of the shallow water table at least seasonally (Section 5.7). This is supported by the shallow depth to water measured in the PCO-series wells. The influence of surface water quality on the groundwater cannot be established from existing data. Surface water flow above TA-18 recharges the shallow groundwater, at least seasonally, and some seasonal variation in the interaction between groundwater and surface water can be expected east of TA-18.

The wells constructed near the LACEF (Figures 5-7 and 5-20) were sampled only once, and many of the potential contaminants of concern were not included in the analysis. In particular, because the purpose of the wells was to develop data only on radionuclide concentrations, analysis for organics and metals was not performed. As with the PCO-series wells, no data regarding seasonal variability are available for these wells.

The objectives of the groundwater sampling are to obtain data on the seasonal variability of the concentrations of potential contaminants of concern, on seasonal water level changes in existing wells, and on local background concentrations of potential contaminants of concern as well as of water quality parameters regulated by the Safe Drinking Water Act. Specific water quality parameters that will be analyzed, referred to here as "General Mineral Content," are bicarbonate, carbonate, alkalinity, calcium, chloride, copper, foaming agents, nitrate, iron, magnesium, manganese, pH, potassium, sodium, sulfate, specific conductance, total dissolved solids, total hardness, and zinc. To the extent that any of these analyses are redundant because of planned analyses for metals (silver, beryllium, chromium, etc.), negotiations will be conducted with the analytical services to avoid duplicate analyses. Many of these latter parameters are useful for verifying that groundwater samples represent zones influenced by potential contaminant sources, even if no potential contaminants of concern are detected in the groundwater.

Specific quality objectives with regard to precision, completeness, and comparability are addressed in the generic QAPjP (LANL 1991, 0553), and are incorporated by reference into the operable unit QAPjP (Annex II of this work plan). Desired minimum detection levels for the potential contaminants of concern have been established as 1/10 of the respective screening action level for a potential contaminant (Section 4.6). Such a detection level will enhance comparison of measured values with the screening action levels.

5.6.4 Sampling Plan

5.6.4.1 PCO-Series Wells

Well PCO-1 will be sampled quarterly, beginning in the fall (September/October) of 1993. Water samples will be collected using a pneumatic pump in accordance with SOPs 06.01, 06.02, and 06.03. These procedures include the field measurement of some water quality parameters such as temperature, pH, conductivity, etc. Samples will be appropriately containerized and analyzed for the constituents as stipulated in Table 5-14. (Well PCO-2, just downgradient from former firing sites in TA-27, will provide data on potential impacts on groundwater quality of those release sites. Water levels will be recorded before sampling is initiated.)

5.6.4.2 LACEF Wells

These four existing wells were only sampled once, in 1990 (LATA 1991, 16-0005), and some sedimentation may have occurred in the well bore. Water levels will be measured before any sampling occurs. It may be necessary to develop the wells by cyclic pumping before sampling can be accomplished. No water will be introduced to the well bore as part of this development. The wells will be allowed to stabilize for one week following development. This will allow for stabilization of any volatile compounds in the water. Water samples will be collected and water levels measured quarterly for the PCO-series wells, as described in Section 5.6.4.1.

5.6.4.3 Surface Water Quality

The surface water hydrology of Pajarito Canyon is not quantified. Large runoff events occur in the spring as a result of snowmelt, and the largest events may occur during heavy thunderstorm activity. Suspended sediment and concentrations of dissolved constituents are commonly higher in storm runoff than

TABLE 5-14

SAMPLING PLAN FOR SHALLOW MONITORING WELLS AND BACKGROUND SOIL/GROUND WATER

			Field Survey							Analytical Laboratory														
Location	Description	Sample Description	Location survey	Geophysical survey	Rad screening (α, β, γ)	PCB field test	TPH field test	HE field test	VOC screening	No. of sampling locations	Mob. lab. rad. screening (α, β, γ)	VOCs (EPA 8240)	SVOCs (EPA 8270)	Metals (EPA 6010)	HE (USATHMA[a])	General mineral (std. methods)	Chloride—soils (EPA 300)	Nitrate—soils (EPA 300)	Uranium (total) (DOE[d])	Plutonium (isotopic) (DOE[d])	Thorium (isotopic) (DOE[d])	Gamma spectroscopy (DOE[d])	TPH (EPA 418.1)	BTEX (EPA 8020)
PCO-1	Shallow well	Water (quarterly)								4	X	X	X	X	X	X			X	X	X	e		
PCO-2	Shallow well	Water (quarterly)								4	X	X	X	X	X	X			X	X	X	e		
PCO-3	Shallow well	Water (quarterly)								4	X	X	X	X	X	X			X	X	X	e		
MW-1	Shallow well	Water (quarterly)								4	X	X	X	X	X	X			X	X	X	e		
MW-2	Shallow well	Water (quarterly)								4	X	X	X	X	X	X			X	X	X	e		
MW-3	Shallow well	Water (quarterly)								4	X	X	X	X	X	X			X	X	X	e		
MW-4	Shallow well	Water (quarterly)								4	X	X	X	X	X	X			X	X	X	e		
BG-1	Borings																							
BG-2		Soil								9	X	X	X	X	X		X	X	X	X	X	e		
BG-3		Water								3	X	X	X	X	X	X			X	X	X	e		

a. US Army Toxic and Hazardous Materials Agency, no date, 0522.
b. Maximum number, assuming all sampled locations show contamination.
c. Geophysical surveys may be used to locate drain fields if technology is proven by ongoing RFIs.
d. HASL-300 (DOE 1983, 0516).
e. Only when gross-gamma is above background.

in snowmelt runoff, but there are no data available to support this proposition. Because of the temporal and spatial variability of surface water quality, a substantial effort is required for proper characterization. 'If Phase I soil and groundwater sampling indicates that contaminants of concern are present in any sampled groundwater, a Phase II investigation will be considered to characterize the potential sources of that contamination. Surface water sampling would be a part of such a characterization program. Limited sampling of surface water in wetland areas is planned (Section 5.7.2).

5.6.4.4 Background Soil and Water Quality Parameters

A significant portion of streamflow in upper Pajarito Canyon appears to infiltrate into the alluvium upstream from TA-18 (Figure 5-21). Groundwater quality in the eastern portion of this infiltration area should reflect the influent quality of the shallow groundwater flowing in the alluvium beneath TA-18 and eastward. Three locations (Figure 5-21) will be selected for soil borings that are not in the drainage channel, but are where saturated conditions are expected. These locations are near the center of the valley, where alluvial material is thickest and the saturated zone is most likely to occur. The locations will be up-canyon (and therefore upgradient) from any potential contaminant source in OU 1093. Core samples will be taken in 5-ft intervals, using a hollow-stem auger (Procedure C-6, Appendix C). The borehole will extend to the shallow water table, expected to be at approximately a 15-ft depth, and groundwater samples will be taken from approximately 2 ft below the water table using a hydropunch (Procedure C-8, Appendix C). Field measurement of water quality parameters will be performed using SOP-06.02. A 1-ft interval of soil material from each 5-ft core will be removed for geochemical analysis. If all three holes do not intersect a saturated zone, alternate locations will be selected. Samples will be submitted for analysis as presented in Table 5-14. If contaminants of concern are detected in any of these soil or groundwater samples, or in any other Phase I groundwater sampling, a background monitoring well will be proposed as part of a Phase II investigation.

5.7 Sampling in Wetland Areas

As presented in Section 3.3.4, there are areas within Pajarito and Threemile canyons that potentially qualify as wetlands. These areas are under review and official delineation of these wetland areas by the Laboratory will be accomplished before field work is initiated.

5.7.1 Data Needs and Data Quality Objectives

Wetlands provide critical habitat for a broad variety of acquatic and terrestrial species, and are thus important in evaluating ecological risk. Specific criteria for evaluating ecological risk are under development by the ER Program, and a complete list of data needs is not presently available; however, the presence of elevated levels of potential contaminants of concern in water, sediments, and plant material will be among the concerns of the ecological risk assessment. Some plant species serve as accumulators of particular contaminants. The

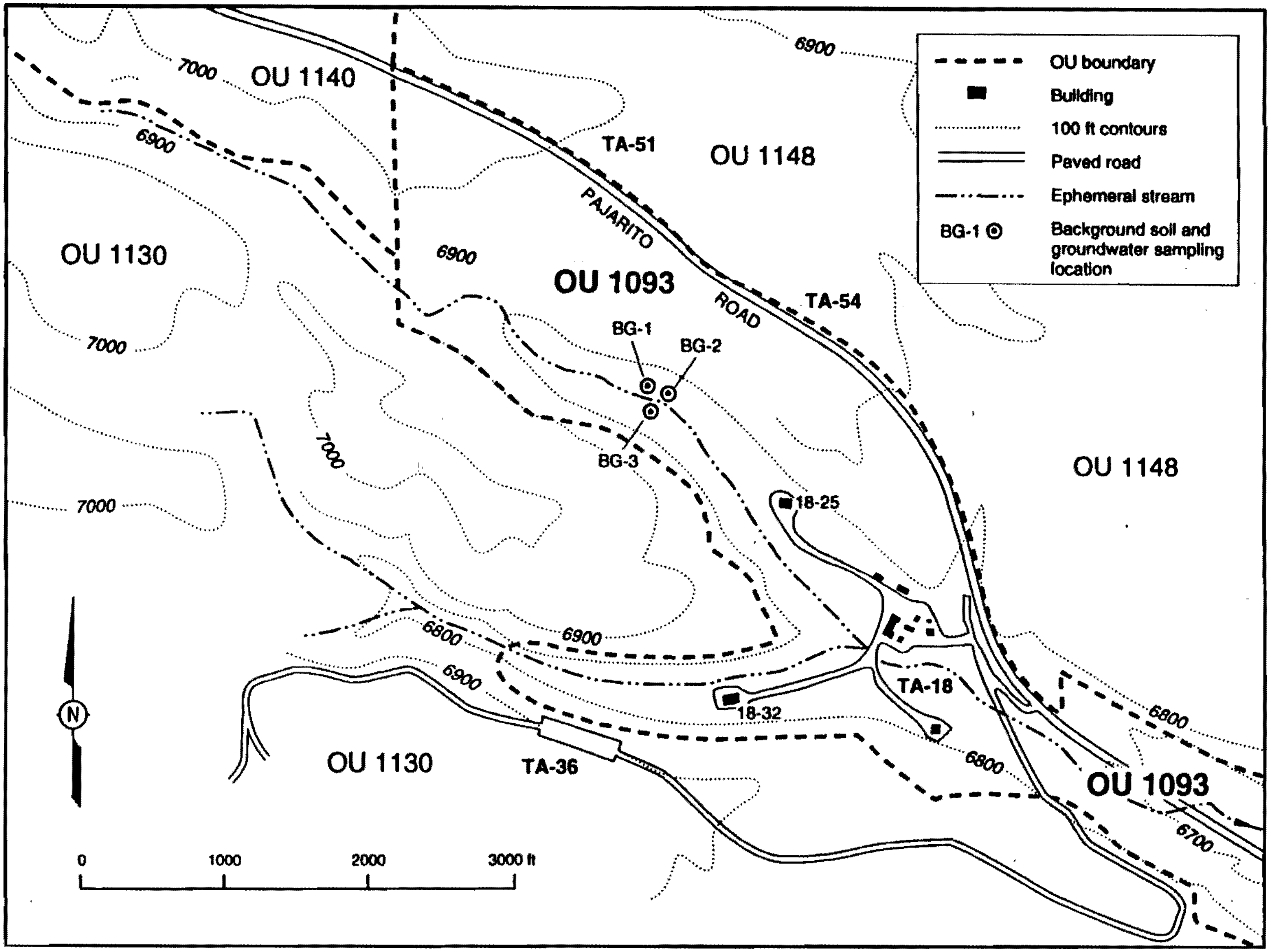


Figure 5-21. Proposed location of background soil and groundwater sampling.

specific objective of the RFI investigation is to ascertain if concentrations of potential contaminants of concern in the environment, as potentially released from PRSs, has resulted in an unacceptable risk to humans or the environment. Movement of potential contaminants through the food chain in wetlands begins with their presence in sediments and water. Independent of their impact on the environment, the presence of potential contaminants of concern needs to be evaluated from a human health perspective. Therefore, in lieu of specific criteria for acceptable concentrations from an environmental perspective, data on potential contaminants of concern will be collected for comparison with screening action levels. When ecological risk criteria are available, the collected data will be evaluated from that perspective and additional sampling will be planned as necessary.

The objective of Phase I investigations will thus be to collect data on concentrations of potential contaminants of concern in sediments and water in the wetland areas. The potential cantaminants of concern consist of all those identifed for PRSs in OU 1093, any of which could be present in these wetland areas. Practical quantitation limits and other quality assurance criteria will be the same as those used for other sampling conducted for screening assessments and will be consistent with the QAPjP (Annex II of this work plan).

Sampling will be focused on areas most representative of the wetland areas: perennial standing water in the main drainage, and sediments associated with these locations. Locations will be selected that permit analysis of incremental contributions from the various potential source areas in OU 1093: facilities at TA-18, previous discharges to the outfall from the sewage lagoons, and deposition from former firing sites. Because of the shallowness of the water table in the wetland areas, many of these areas of perennial open water may reflect the position of the water table, or at least be in intimate hydraulic contact with the water table. Sampling of surface water in these areas therefore contributes, if only indirectly, to an understanding of characteristics of the shallow groundwater system.

Should the data from Phase I prove inadequate for assessing ecological risk, consideration will be given to Phase II sampling. That sampling could include key indicator plant species in local wetland areas, such as the broadleaf cattail (*Typha latiflolia*) and coyote willow (*Salix exigua*).

5.7.2 Sampling Plan

Proposed sampling locales are indicated in Figures 5-22 and 5-23. The wetland area in Threemile Canyon (Figure 5-22) was potentially influenced by former firing site activity. Sampling locales WL-1 through -3 are located there. The two sampling locales immediately east of TA-18, WL-4 and -5 (Figure 5-23), will evaluate the combined effects of all former firing sites in TA-18 and the existing and former facilities in TA-18. Two locales were selected near the outfall from the sewage lagoons (WL-6 and -7), and two in the area potentially affected by former TA-27 firing sites (WL-7 and -8) (Figure 5-23).

At each locale, two water samples will be collected using the Surface Water Sampling Procedure (SOP-06.13). Field measurement of water quality

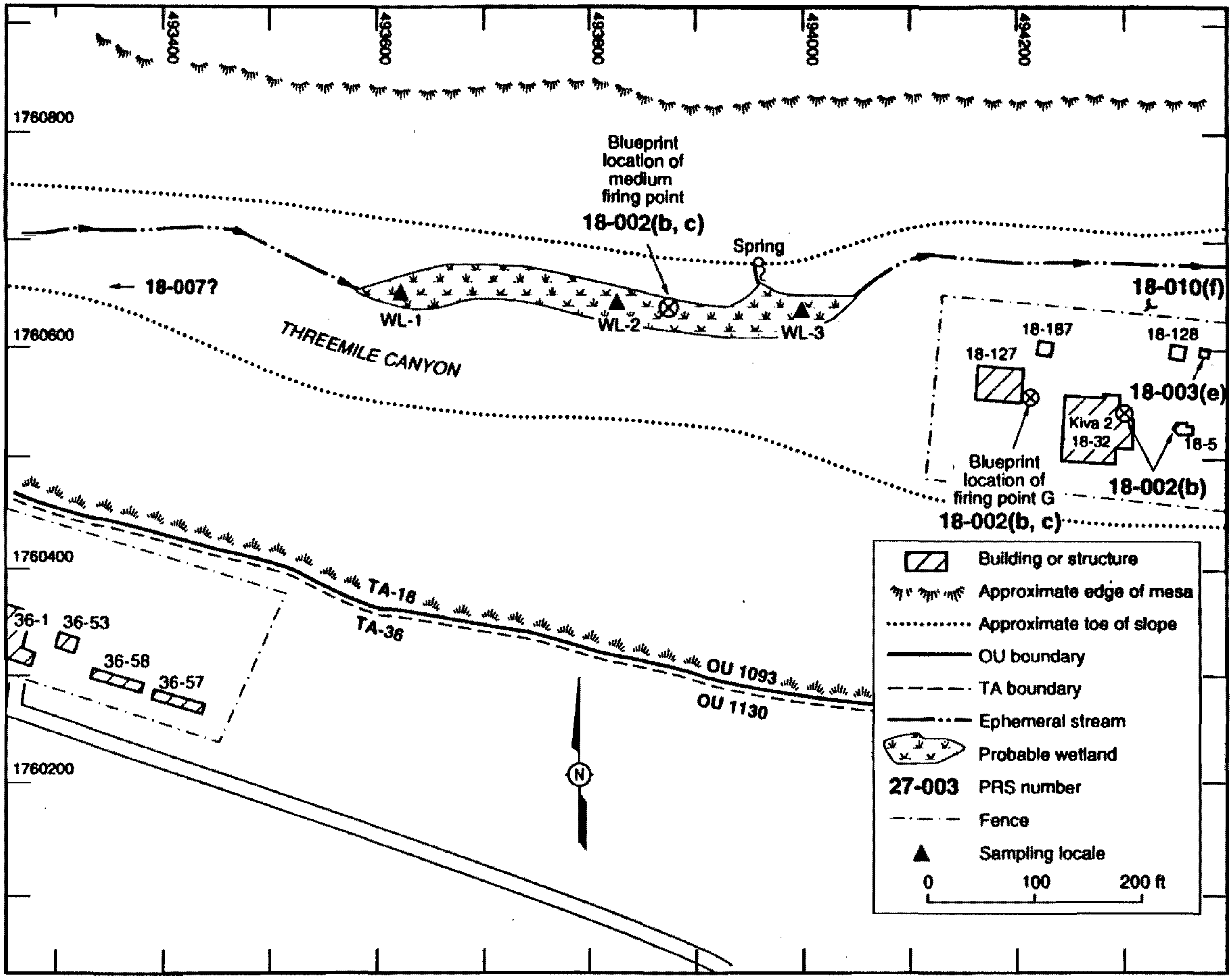


Figure 5-22. General location of wetland sampling in Threemile Canyon.

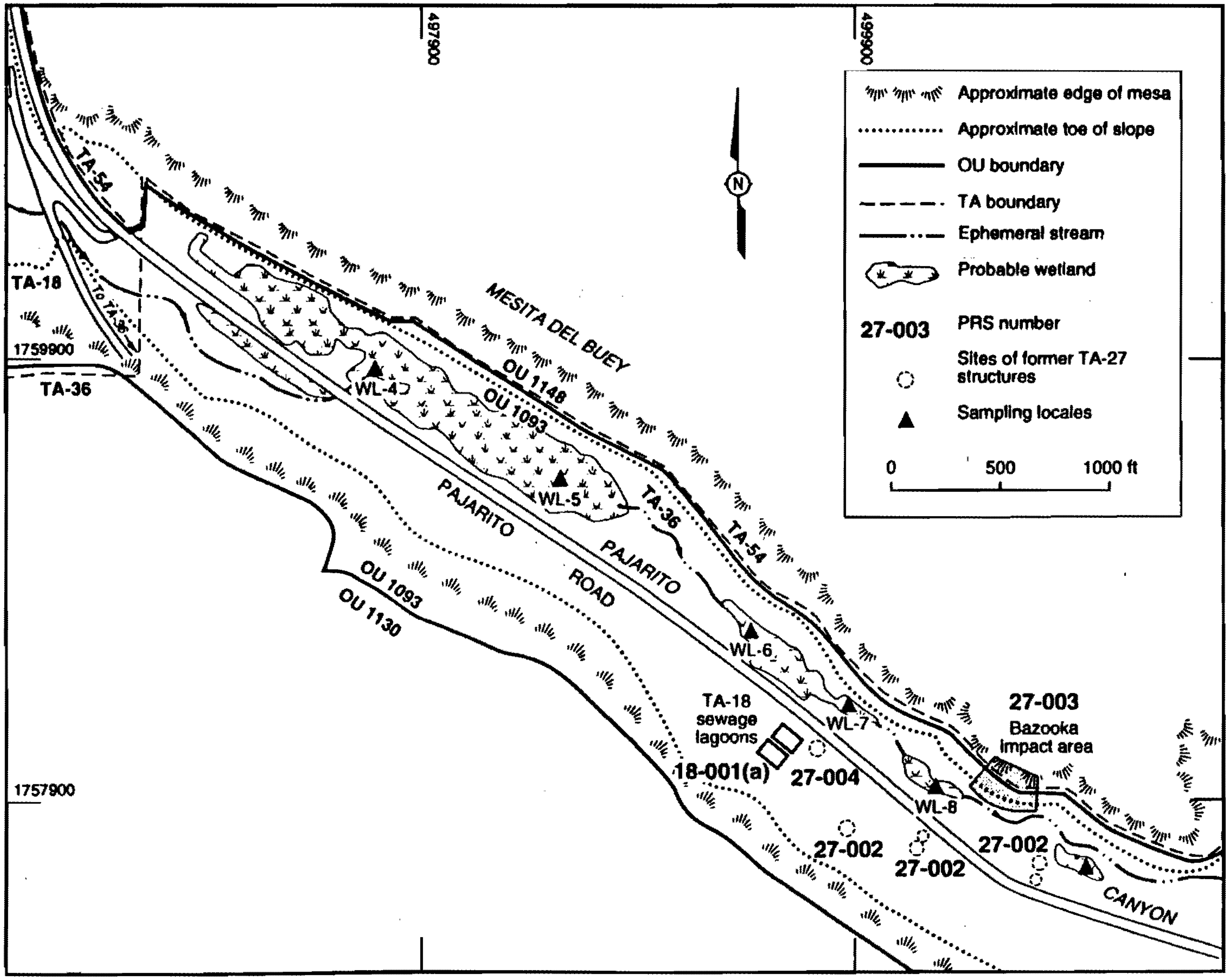


Figure 5-23. General location of wetland area in central portion of OU 1093.

parameters will be performed using SOP-06.02. Concentrations of potential contaminants of concern should be relatively uniform within a given small body of water, and two samples will provide an initial estimate of that uniformity. Concentrations of potential contaminants of concern in sediments may vary considerably, depending on the deposition process. Therefore, four locations at each locale will be selected. The bottom area of the locale will be divided into quarters, and one sample from the 6- to 18-in. depth interval of bottom sediments will be collected from the center of each using a hand corer (Procedure C-7, Appendix C). Sampling of older (deeper) sediments will provide a better measure of the effects of past operations, whereas samples from the surface layer of sediments would more likely represent the effects of present operations. Any discharges of potential contaminants of concern would probably have resulted from former operations because changes in operations at TA-18 and alterations in Laboratory practice make such discharges from present operations less likely.

All samples will be submitted to an analytical laboratory for analysis of potential contaminants of concern potentially deposited to the surface water/wetland environment, as indicated in Table 5-15, and to detect water quality parameters (Section 5.6.3). The results of sample analysis will provide input for developing a work plan for the Canyons Operable Unit and for human and ecological risk assessment for OU 1093.

TABLE 5-15

SAMPLING PLAN FOR WETLAND AREAS

Sampling Locale	Description	Sample Description	Field Survey							Analytical Laboratory														
			Location survey	Geophysical survey	Rad screening (α, β, γ)	PCB field test	TPH field test	HE field test	VOC screening	No. of sampling locations	Mob. lab. rad. screening (α, β, γ)	VOCs (EPA 8240)	SVOCs (EPA 8270)	Metals (EPA 6010)	HE (USATHMA[a])	General mineral (std. methods)	Chloride—soils (EPA 300)	Nitrate—soils (EPA 300)	Uranium (total) (DOE[d])	Plutonium (isotopic) (DOE[d])	Thorium (isotopic) (DOE[d])	Gamma spectroscopy (DOE[d])	TPH (EPA 418.1)	BTEX (EPA 8020)
WL-1 through	Wetland																							
WL-8	Areas	Sediments								32	X	X	X	X	X				X	X	X	[e]		
		Surface water								16	X	X	X	X	X	X			X	X	X	[e]		

a. US Army Toxic and Hazardous Materials Agency, no date, 0522.

b. Maximum number, assuming all sampled locations show contamination.

c. Geophysical surveys may be used to locate drain fields if technology is proven by ongoing RFIs.

d. HASL-300 (DOE 1983, 0516).

e. Only when gross-gamma is above background.

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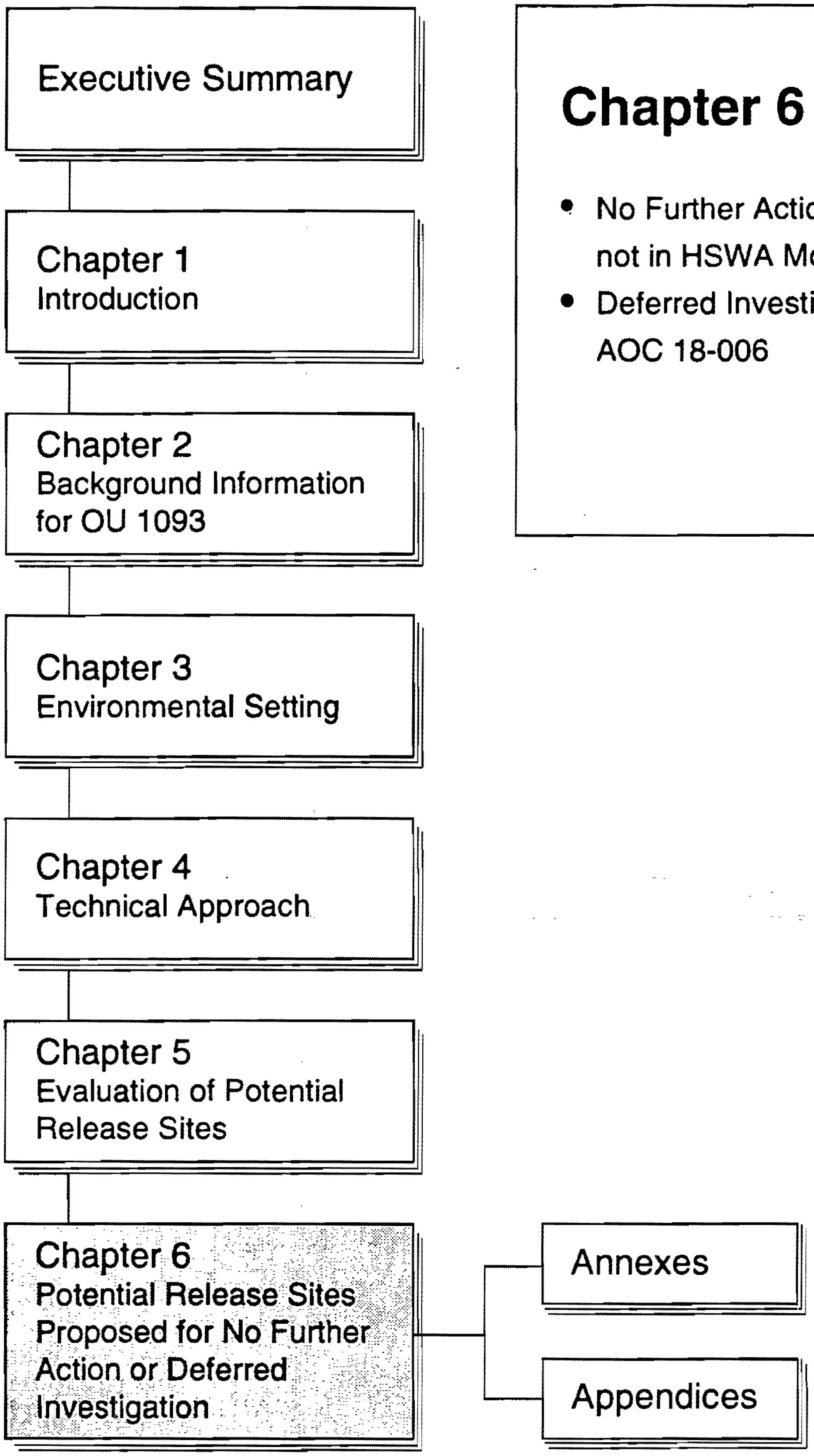

Chapter 6

- No Further Action for PRSs not in HSWA Module
- Deferred Investigation for AOC 18-006

6.0 POTENTIAL RELEASE SITES PROPOSED FOR NO FURTHER ACTION OR DEFERRED INVESTIGATION

This chapter describes PRSs for which NFA is recommended based on existing information. These PRSs are grouped as follows:

- Eleven AOCs are grouped together that are not listed in Table A of the HSWA Module and for which NFA is being proposed. No permit modification is required for approval of NFA for these AOCs.
- AOC 18-006 does not contain RCRA-regulated constituents and is not listed in Table A of the HSWA Module. Deferred action is recommended for this AOC.

6.1 No Further Action for PRSs Not Included in the HSWA Module

None of the AOCs described in this section are listed in the HSWA Module. Approval for NFA for these AOCs does not require a permit modification.

6.1.1 AOC C-18-002 - Assembly Building

6.1.1.1 Description

This assembly building (TA-18-10) was located north of Pajarito Road on the mesa above the present location of TA-18. It was used for the assembly of explosive devices tested at either TAs-18 or -27. Material handled inside the building would probably have included high explosives, uranium, and thorium. There is no documented evidence to suggest that any systematic or even occasional releases occurred from this building. The building was moved to TA-5 between 1947 and 1948 (DOE 1987, 0264). The former location of this building is presently within TA-54, which is outside the boundary of OU 1093 (Figure 1-3).

6.1.1.2 Justification for No Further Action

The building and contained operations were not related to waste management; it served only to house assembly operations. Because the site area has been cleared and regraded, the exact location of the former building is not evident. The source of potential contamination no longer exists and there is no evidence that radioactive or hazardous releases occurred from this building. For these reasons the site was designated as an AOC in Appendix C of the SWMU Report (LANL 1990, 0145) rather than as a SWMU. NFA is proposed for this AOC.

6.1.2 AOC C-18-003 - Radioactive Waste Storage Area

6.1.2.1 Description

Appendix C of the SWMU Report (LANL 1990, 0145) indicates the possibility of a radioactive waste storage area behind Building TA-18-1 (Figure 1-2). A June 1992 site inspection did not reveal such storage and discussions with site personnel (Section 5.4.1) indicated that no radioactive materials have been stored in that location for a number of years.

6.1.2.2 Justification for No Further Action

No radioactive materials (waste or otherwise) are presently stored in outside areas at TA-18 and the exact location of the possible radioactive waste storage area was not provided in the SWMU Report. Thus, sampling cannot be performed. There is no evidence to suggest that releases occurred at this site, and it was, thus, designated as an AOC in the SWMU Report (LANL 1990, 0145). Sampling of storm sewer outfalls (Section 5.4.1) is designed to determine if any residual contamination is present at and below outfalls from possible previous radioactive waste storage at TA-18. That sampling will, therefore, evaluate whether any contaminants may have entered the environment as a result of possible waste storage at this AOC. The detection of contamination above screening action levels could lead to an in-depth evaluation for potential source areas throughout TA-18 as part of a Phase II investigation. Such an investigation would inevitably include any areas where waste materials could have been stored, including this AOC. Thus, NFA is proposed for this AOC.

6.1.3 AOC 18-009(a) - PCB Transformer

6.1.3.1 Description

According to the SWMU Report, a transformer [AOC 18-009(a)] located at Structure TA-18-136 (Figure 1-2) leaked PCB-contaminated oil in 1982. This PRS has been designated as an AOC because PCBs are not contaminants regulated by RCRA or HSWA. No data were located on PCB concentrations in the transformer. According to a Laboratory employee (Emelity 1982, 16-0050), approximately 50 cubic yards of PCB-contaminated soil was removed the same year. The memo gave no indication regarding the levels of PCB concentrations in the removed soil.

6.1.3.2 Justification for No Further Action

A site visit to the former location of this AOC was made in July 1992. The only evidence of the past transformer was a capped-off conduit in which electrical cables ran underground to Kiva 3. The concrete pad on which the transformer sat and the contaminated soil have been removed. Because the area was cleaned up and the transformer was removed, NFA is proposed.

6.1.4 AOCs 18-009(b) and (c) - PCB Transformers

6.1.4.1 Description

Transformers [AOCs 18-009(b) and (c)] at Stations TA-18-46 and -148 (Figure 1-2) were both removed in 1988 (LANL 1990, 0145). One of the three transformers at Station TA-18-46 contained oil with PCB concentrations above 50 ppm (Assaigai Analytical Laboratories, Inc. 1984, 16-0048; LANL 1992, 16-0047). No data were discovered regarding the transformer(s) at Station TA-18-148. According to the SWMU Report (LANL 1990, 0145), these transformers were inspected before removal. There is no evidence from engineering records that leaks occurred. These sites were designated as AOCs because PCBs are not regulated by RCRA or HSWA.

6.1.4.2 Justification for No Further Action

A July 1992 onsite inspection of these two locations revealed that the transformers have been replaced with transformers containing less than 50 ppm PCBs. Because there is no evidence of past or present leaks, NFA is proposed for these two AOCs.

6.1.5 AOC 18-009(d) - PCB Transformer

6.1.5.1 Description

According to the SWMU Report, a transformer at Station TA-18-142 (Figure 1-2) leaked PCB-contaminated oil in 1988. According to documentation (Bailey 1992, 16-0049), oil was observed around the fill valve and bushing horns of this transformer. The fill valve is on the upper part of the transformer and the bushing horns are located at the transformer switch-gear connection. The release points on the transformer had an oily sheen under the fill valve and under the bushing horns. The PCB concentration was 101 ppm, and the volume leaked was estimated to be 1 teaspoon. There was no oil on the concrete pad below these areas. This site is designated as an AOC because PCBs are not regulated by RCRA or HSWA.

6.1.5.2 Justification for No Further Action

According to cleanup documentation (Bailey 1992, 16-0049), the fill valve, surface below the fill valve, underside of the bushing horns, junction boxes, and underside of all bushing horn junction boxes were cleaned. A double wash/double rinse was done on the surfaces using Viking Electric R-30 solvent. The solvent was applied with rags and a wire brush. After the cleanup, a close inspection of the areas where the leaks had occurred indicated the oil had sweated out. A 1992 visual inspection showed no signs of leakage. Because the leakage was cleaned up, there was no release to the environment, and there are no indications of present leakage, NFA is proposed for this AOC.

6.1.6 AOC 18-009(e) - PCB Transformer

6.1.6.1 Description

A 1983 capacitor fire in the pumphouse for Pajarito Mesa Well No. 2 (TA-18-252) (Figure 1-2) resulted in PCB contamination of walls, ceiling, floor, and installed equipment. According to the SWMU Report, firefighters used extinguishers and water to douse the blaze, resulting in the contamination of the floor and soil surrounding the door. Soil in the affected areas was excavated to depths at which PCBs were no longer detected, but available documentation does not stipulate what detection levels were used. The excavated soil reportedly was disposed of at Material Disposal Area G. The building and equipment were cleaned with Fantastic brand cleaner and repainted. According to a 1984 memo (Ortiz 1984, 16-0001), sandblasting and painting the interior walls, ceiling, and floor were both recommended and performed. A 1992 interview (Hesch 1992, 16-0046) indicated that the equipment, as well as the pumphouse interior, was washed down. This site is designated as an AOC because PCBs are not regulated by RCRA or HSWA.

6.1.6.2 Justification for No Further Action

This AOC was apparently included in the SWMU Report because of a presumed potential for continuing release from the equipment in the pumphouse, rather than because of the contaminated soil (which was cleaned up). The 1984 memo referenced above indicated that only air concentrations of PCBs **inside** the building were of concern. The sandblasting and painting referred to above were designed to mitigate those releases. Some PCB contamination of interior surfaces of the pump motor may still exist, and routine monitoring of air inside the building accompanies any maintenance work in the building. While some atmospheric release of PCBs or decomposition products (either aerosols or vapors) may still be continuing, these releases do not represent a concern subject to or requiring environmental remediation. It is entirely an occupational health issue. Therefore, NFA is proposed.

6.1.7 AOC 18-010(a) - Storm Sewer Outfall

6.1.7.1 Description

This storm sewer system drains water from the roof of Building TA-18-30 through a series of roof drains located on the west side of the building. It outfalls south of the southwest corner of the building (Figure 2-7). This site is designated as an AOC because there is no evidence to suggest that any waste materials or contaminants are present in the discharge.

6.1.7.2 Justification for No Further Action

According to an engineering drawing (LASL 1955, 16-0002), the only sources of water handled by this AOC are rainwater or melting snow from the roof of Building TA-18-30. This AOC, along with other storm sewer outfalls, was apparently included in the SWMU Report because of its presumed potential for draining areas where radioactive or hazardous materials had been stored. However, the drain serves only the roof of Building TA-18-30, where no storage has occurred. Because no contaminants could have been introduced into this outfall, NFA is proposed.

6.1.8 AOC 27-004 - Control Building

6.1.8.1 Description

Control Building TA-27-2 was a small subsurface concrete firing site bunker covered with earthen fill that was used at TA-18. It was transferred to and reconstructed at the northwest end of TA-27 about 1945 (Figure 1-4). Demolished when the site was decommissioned in mid-1960, it was the only building at TA-27 reported to have any radioactive contamination (DOE 1987, 0264). The site is designated as an AOC because only radioactive contaminants, which are not regulated by RCRA or HSWA, were present.

Beta and gamma contamination were identified on the concrete floor of Building TA-27-2 in 1958 (DOE 1987, 0264). Decontamination efforts in 1959 were unsuccessful. A 1960 survey (DOE 1987, 0264) conducted before the structure was removed showed thorium (a low-energy gamma emitter) contamination remaining inside the concrete structure. Radiation levels were reported as 1,500 counts per minute (presumably alpha) and 2 millirad/hour thorium (DOE 1987, 0264). A 1988 beta and gamma screening of the remaining building rubble did not reveal gamma exposure rates above background levels (LANL 1990, 0145).

6.1.8.2 Justification for No Further Action

The general area where Building TA-27-2 was located has undergone extensive alteration with the construction of the TA-18 sewage lagoons and the realignment of Pajarito Road (Figure 1-4). The actual former location, as provided by a site map (LASL 1955, 16-0063), cannot be verified. A small quantity of concrete rubble is evident near the presumed location of the building. The radiation monitoring of this rubble done in 1988 did not reveal beta or gamma exposure rates above background levels (LANL 1990, 0145). (The original contamination on the building floor was identified as beta-gamma radiation.) Because the exact location of the building cannot be determined and current evidence indicates no contamination is present, NFA is proposed.

6.1.9 SWMU 18-012(d) - Unidentified Drains

6.1.9.1 Description

The SWMU Report (LANL 1990, 0145) indicates that "drains of unknown origin and purpose are located behind Building TA-18-129 and are marked with a cement post." These drains satisfy the definition of a SWMU (Section 1.1) and are so designated.

6.1.9.2 Justification for No Further Action

A June 1992 site inspection did not locate the drains or the post. An engineering drawing (LASL 1969, 16-0045) does not show any drains in Building TA-18-129. It is possible that the posts marking the drains [AOC 18-012(c)] from nearby Building TA-18-141 were mistakenly identified as a separate drain. Because this drain does not appear to exist as a separate drain from those drains already identified, NFA is proposed.

6.1.10 AOC C-18-001 - Photochemical Laboratory

6.1.10.1 Description

This AOC, identified in Appendix C of the SWMU Report (LANL 1990, 0145), was associated, as such, with former portions of Building TA-18-1. It was not a waste management unit; therefore, it is designated as an AOC in this work plan.

6.1.10.2 Justification for No Further Action

The portion of Building TA-18-1 that contained the photochemical laboratory has been dismantled. The liquid waste discharges from that portion of the building were routed through the drain lines and septic system associated with SWMUs 18-003(g) and (h) (Sections 5.1.1.2.7 and 5.1.1.2.8). The sampling plans for these SWMUs acknowledge the possible presence of silver from photochemical waste discharges. Therefore, this AOC is proposed for NFA.

6.2 Deferred Investigation for AOC 18-006 - Uranium Solution Pipe

6.2.1 Description

Building TA-18-168 was the Dynamic Critical Assembly Facility, renamed Los Alamos Critical Experiment Facility (LACEF), near Kiva 1 (Figure 2-3). Built in 1969, Building TA-18-168 contained the Kinglet fission reactor, an aboveground containment vessel. It contained a liquid uranyl sulfate solution that was used as fuel for fission reactions. When not in the aboveground reactor, the solution was stored in a stainless steel pipe that is buried 5 ft deep at the south side of the building and extends 100 ft west to the fence corner (Figure 2-3) where aboveground hardware associated with the pipe is visible. The uranyl sulfate solution was removed from the storage pipe when the series of experiments at the reactor was completed, but the pipe was left in place. The pipe is not a waste management unit, and because there is no evidence of any releases, it has been designated as an AOC.

6.2.2 Justification for Deferred Investigation

Data on potential environmental contamination from AOC 18-006 (and other PRSs located nearby) were obtained by an investigation performed in support of a safety analysis report (LATA 1991, 16-0005) for the LACEF, which is housed in Building TA-18-168 (Section 5.1.2.1.2). Soil and groundwater samples were collected both upgradient and downgradient from AOC 18-006.

The data indicate that no significant differences in radionuclide concentrations in soil exist between the downgradient and upgradient locations or from offsite background sampling locations. All measured radionuclide concentrations in the downgradient water samples were below detection levels. These detection levels are well below proposed screening action levels for groundwater (Section 5.1.2.1.2).

A 1992 telephone interview (Hesch 1992, 16-0044) indicated that the storage pipe does not presently contain radioactive solutions in quantities of consequence. Future plans for using or decommissioning this storage pipe have not been developed. This storage pipe was specifically designed and fabricated to contain radioactive solutions and does not appear to be a source of contamination in the surrounding soil and water based on samples from the nearby monitoring wells. Because the operating group at TA-18 elects to retain the option of using the pipe in the future, the pipe cannot be excavated at this time. Information on the possible presence of contamination immediately surrounding the pipe cannot be obtained without excavating, or at least completely exposing the pipe. Such an excavation runs the risk of damaging the pipe, precluding its future utility. Such sampling will occur when the pipe is eventually removed, at or before site decommissioning. Because evidence from soil and groundwater monitoring indicates that the pipe is not a present source of significant environmental contamination, it is proposed that investigation of this AOC be deferred to a later date. Future decontamination and decommissioning activities will address this AOC.

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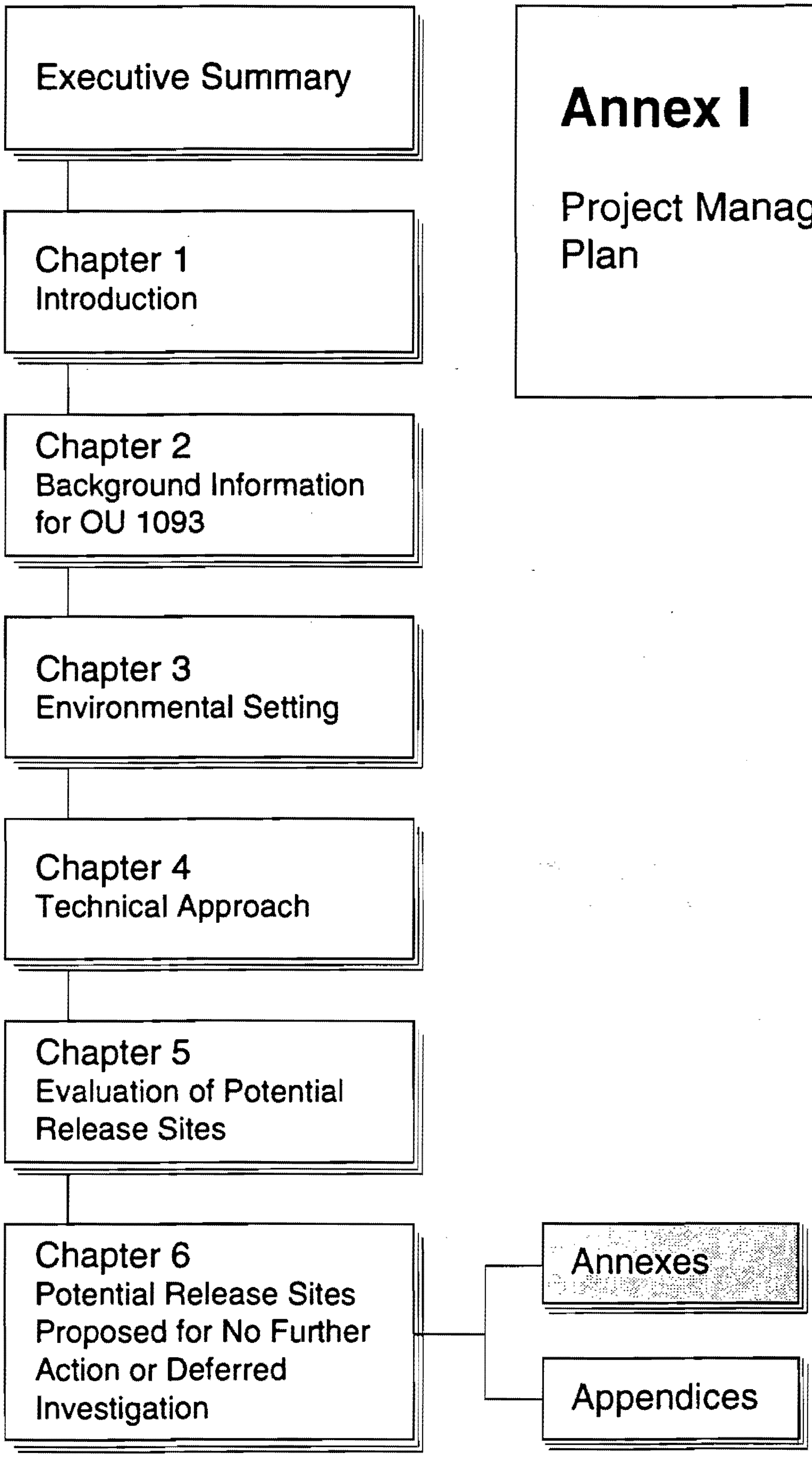
Annex I

Project Management Plan



Executive Summary

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Introduction

Chapter 2
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Chapter 4
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Annexes

Appendices

1.0 PROJECT MANAGEMENT PLAN

This annex provides the technical approach, schedule, reporting requirements, budget, organization and responsibilities for the implementation of the (RCRA) facilities investigation (RFI) for OU 1093. This project management plan (PMP) is an extension of ER Program's Management Plan described in Annex I of the IWP (LANL 1992, 0768) and follows the DOE's basic management philosophy outlined in DOE Order 4700.1, Project Management System (DOE 1987, 0069). This annex discusses the requirements for PMPs set forth in the HSWA Module (Task II, E, p. 39) of the Laboratory's permit to operate under RCRA (EPA 1990, 0306) as they pertain to OU 1093. Qualifications of key personnel, including contractors, are also provided.

1.1 Technical Approach

The technical approach to the RFI for OU 1093 is described in Chapter 4 of this work plan. This approach is based on the ER Program's overall approach to the RFI/corrective measures study (CMS) process as described in Chapter 4 of the IWP. The following key features characterize the ER Program's approach:

- use of preselected "screening action levels" as criteria to trigger voluntary corrective action (VCA) or Phase II investigations;
- site characterization based on a "sample and analysis" approach;
- use of decision analysis and cost-effectiveness studies in selecting remedial corrective measures and their remedial alternatives; and
- the application of an "observational," or "streamlined," approach to the RFI/CMS process.

The general philosophy of the RFI/CMS process is to develop and iteratively refine the OU 1093 conceptual exposure model through carefully planned stages of investigation and data interpretation. This will be followed by a study that investigates and proposes various methods for addressing potential release sites (PRSs) that are determined to need remediation. Another objective is to use the minimum data necessary to support either interim corrective measures or a CMS.

1.2 Technical Objectives

The technical objectives of this work plan, and the subsequent RFI, are to

- locate, or confirm the location of, each PRS within OU 1093;
- through Phase I investigations, identify contaminants present at each PRS and the concentrations within structures and environmental media;

- conduct VCAs and propose no further action (NFA) or Phase II investigations as appropriate;

- determine the vertical and horizontal extent of the contamination at each PRS during Phase II investigations, as may be required;

- identify contaminant migration pathways during Phase II investigations;

- acquire sufficient information to allow quantitative assessment of migration pathways and the associated risk for all PRSs carried forward to Phase II investigations; and

- determine if a CMS is required.

2.0 SCHEDULE

The plan and schedule for the RFI/CMS process were developed as a joint effort between the operable unit project leader (OUPL) and the management information system staff of the ER Program Office. The initial step was to develop and agree on an ER Program-wide work breakdown structure at the upper levels (i.e., Level 1 down through Level 3, which included all the operable units). Level 3 was expanded for OU 1093 and all the necessary activities were graphically laid out on a detailed logic diagram. All of the activities were related to each other by sequence (i.e., before, after, or in parallel with). Duration (in working days) and cost estimates (in dollars) were made for each of the activities. The schedule and cost estimate were calculated as a function of time and were calculated first as a financially unconstrained case and were then replanned to account for constrained funding, which was already allocated for fiscal year (FY) 92. Key milestones for the RFI are presented in Table I-1. A CMS is not anticipated for OU 1093, but will be scheduled if Phase II investigations indicate a need.

Implementation of RFI activities is contingent on regulatory review and approval of this work plan and on available funding. The assumptions used to generate this schedule include the following:

- Review and approval of the work plan and supporting project plans by regulatory agencies are scheduled to be completed by September 1, 1993.

- Certain tasks may be initiated before the regulatory agencies grant final approval of the work plan.

- PRSs expected to require subsequent investigations have been scheduled earlier in the RFI to allow time for data assessment and subsequent investigations.

TABLE I-1

SCHEDULE FOR OU 1093 RCRA FACILITY INVESTIGATION AND CORRECTIVE MEASURES STUDY

Milestone	Date
Start RFI Work Plan	10/01/91
DOE Draft RFI Work Plan Completed	01/22/93
EPA/New Mexico Environment Department (NMED) RFI Work Plan Submitted	05/14/93
EPA/NMED Draft of Phase I Report Completed	03/30/95
EPA/NMED Draft of RFI Report Completed	03/06/97

- The schedule assumes that an adequate number of support personnel (e.g., health and safety technicians, trained drilling contractors) will be available for conducting necessary tasks.
- EPA review and comments on phase reports/work plan modifications are assumed to take two months. Another month is allowed for Laboratory revision and EPA final approval.
- Adequate funding is available to accomplish the work shown in the plan and schedule.

3.0 REPORTING

Results of the RFI field work will be presented in four principal documents:

- Quarterly technical progress reports.
- Phase reports/work plan modifications.
- RFI report.
- CMS report (as required).

These reports are summarized in the following sections. A schedule for submission of draft and final reports is presented in Table I-2.

3.1 Quarterly Technical Progress Reports

As the OU 1093 RFI is implemented, technical progress will be summarized in quarterly technical progress reports submitted by the ER Program, as required by

TABLE I-2

REPORTS PLANNED FOR THE OU 1093 RFI

Type of Report and Subject	Draft Date	Final Date
Quarterly Technical Progress Reports • Summary of Technical Activities and Data		02/15 (yearly) 05/15 (yearly) 08/15 (yearly) 11/15 (yearly)
Phase Reports/Work Plan Modifications • Phase I Report • Phase II Report		
RFI Report • Final RFI Report	04/07/97	

the HSWA Module of the Laboratory's RCRA Part B operating permit (Task V, C, p. 46). Detailed technical assessments will be provided in phase reports/work plan modifications.

3.2 Phase Reports/Work Plan Modifications

Phase reports/work plan modifications will be submitted at the end of each phase for work conducted on PRSs in this operable unit. The first report will summarize Phase I results on initial site characterization and describe the proposed follow-on activities of Phase II, including any modifications to field sampling plans suggested by the Phase I results. This report will also identify any PRSs proposed for NFA. A Phase II report (as distinct from a final RFI report) will be prepared only if Phase III investigations are proposed. This is unlikely for OU 1093. The standard outline for a phase report/work plan modification is presented in Section 3.5.1.2 of the IWP (LANL 1992, 0768) and may be modified as needed.

3.3 RFI Report

The RFI report will summarize all field work conducted during the 2.7-year duration of the RFI. The RFI report will describe the procedures, methods, and results of field investigations and will include information on the types and extent of contamination, sources and migration pathways, and actual and potential receptors. The report will also contain adequate information to support the delisting of NFA sites and corrective action decisions.

3.4 CMS Report

A CMS is not anticipated for OU 1093. However, if needed, the CMS report will propose methods of remediation for selected PRSs listed in the RFI report. Not all PRSs will need remediation because some will have been delisted based on recommendations made in the RFI report. The CMS report will describe the proposed remediation methods, procedures, and expected results, along with a plan, schedule, and cost estimate.

4.0 BUDGET

It is impractical (almost impossible) to separate schedule and cost because changing one affects the other. For example, the start and end dates for OU 1093 were fixed by a combination of regulations and the ER Program Office. These schedule decisions affect the cost as a function of time.

The detailed planning, scheduling, and cost estimating were done in late FY 91. As stated previously, the schedule and cost estimate were calculated first as a financially unconstrained case and were then replanned to account for constrained funding that was allocated for FY 92. DOE funding decisions are set two years in advance (in this case, for FYs 92 and 93). Therefore, the first year that OU 1093 RFI is not constrained by past budget decisions could be FY 94. Although the FY 93 budget is set by DOE, the allocation has not been made to the Laboratory. Funding requests for FY 94 and beyond will reflect the schedule and cost that are the most efficient (unconstrained) for executing the work plan.

Table I-3 presents project costs for completion of the RFI for OU 1093. Each activity on the logic network was assigned one or more resources (i.e., people, materials, or equipment). Through a rate table, the resources were converted to dollars. The estimated costs are escalated for all years beyond FY 92 and do not contain contingency. To avoid adversely affecting the performance analysis calculations, contingency is held in a management reserve account.

The plan, schedule, and budget (allocation) for FY 92 are now baselined by the DOE's Albuquerque Operations Office. The outyears, FY 93 through 98, are not baselined and cannot be until allocations are made by DOE.

5.0 OU 1093 ORGANIZATION AND RESPONSIBILITIES

The organizational structure for the ER Program is presented in Chapter 3 of the IWP (LANL 1992, 0768). ER Program personnel are identified to the technical

TABLE I-3

ESTIMATED COSTS OF COMPLETING RFI OU 1093

Estimate to Complete	$ 9,360,000
Escalation	$ 972,000
Prior Years	$ 712,000
Total at Completion	$11,044,000

team leader (TTL) and OUPL level in Figure 3-2 of the IWP, which is reproduced here as Figure I-1. Section 3.3 of the IWP identifies line authority and personnel responsibilities for each position identified in the figure. Records of qualifications and training of all personnel working on the OU 1093 RFI field work will be maintained as ER records. Summaries of their qualifications are presented in Section 6 of this annex. Contributors to the work plan are included in Appendix A.

The management organization for field investigations is shown in Figure I-2. The names of individuals assigned to the positions indicated in the figure have not been determined at this time. The following sections define the responsibilities of the positions identified in Figure I-2.

5.1 Operable Unit Project Leader

The responsibilities of the OUPL are to

- oversee day-to-day operations, including planning, scheduling, and reporting of technical and administrative activities;
- ensure advance preparation of scientific investigation planning documents and procedures;
- prepare monthly and quarterly reports for the ER Program Manager;
- coordinate with TTLs;
- oversee RFI field work and manage the field teams manager;
- oversee subcontractors, as appropriate;
- conduct technical reviews and direct preparation of final reports;
- comply with the Laboratory's technical requirements for the ER Program;
- interface with the ER quality program project leader (QPPL) to resolve quality concerns and participate with the quality assurance (QA) staff on audits; and
- comply with the ER Program requirements for health and safety, records management, and community relations.

ENVIRONMENTAL RESTORATION PROGRAM

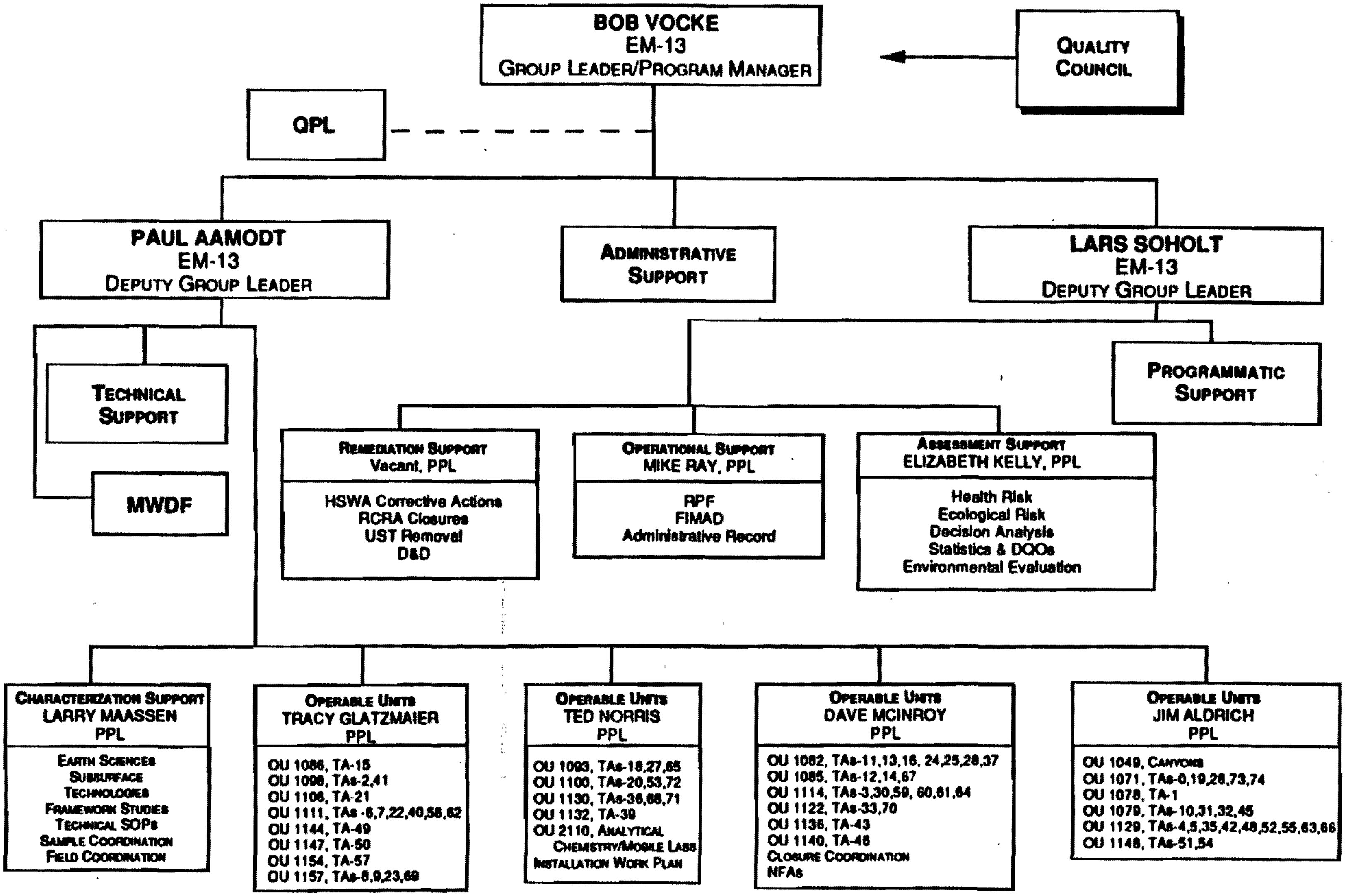

Figure I-1. ER Program organizational structure.

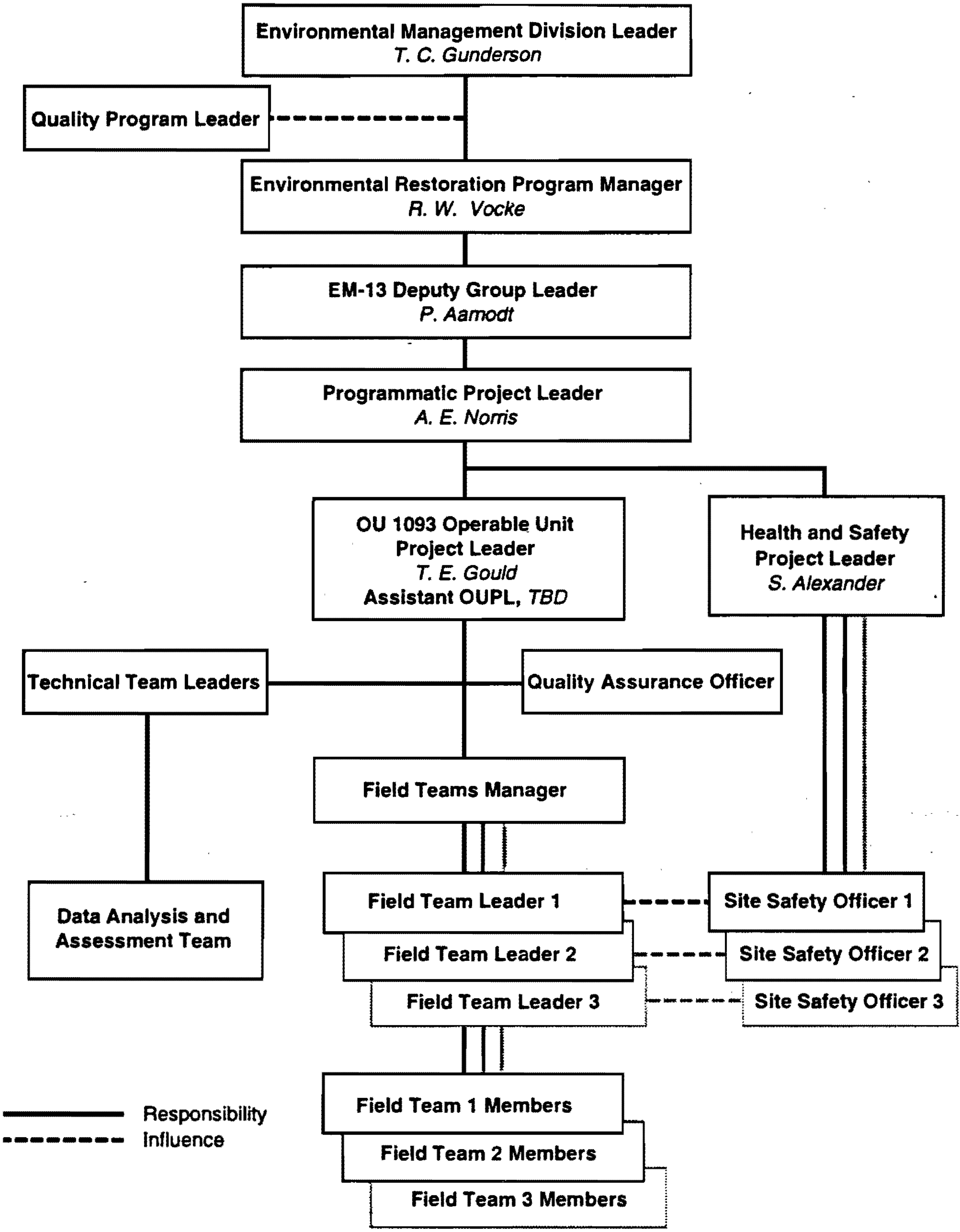

Figure I-2. OU 1093 field organization chart.

5.2 Assistant to Operable Unit Project Leader

The assistant to the OUPL assists the OUPL and acts in the absence of the OUPL.

5.3 Health and Safety Project Leader

The health and safety project leader sets policies and standards of health and safety for the OU 1093 RFI and supervises the site safety officers.

5.4 Quality Assurance Officer

The quality assurance program that governs the design and implementation of the RFI for OU 1093 is described in Annex II, Quality Assurance Project Plan. The QA officer is responsible for ensuring that these plans are properly incorporated into the implementation of the field investigation, including the selection and location of sampling points, sample collection and processing, data handling, and reporting of results. As shown in the project organization chart, the QA officer reports directly to the OUPL, ensuring the independence of the QA officer from field activities. Although the field team leader has the responsibility of ensuring that all necessary procedures are followed, this independent oversight by the QA officer will provide an extra measure of assurance that the QA program is properly implemented at all stages of the investigation.

5.5 Field Teams Manager

The field teams manager directs day-to-day field operations and conducts planning and scheduling for the implementation of the RFI field activities detailed in Chapter 5.

5.6 Technical Team Leader(s)

TTLs are responsible for providing support in their discipline throughout the RFI/CMS process. During the OU 1093 RFI, the TTLs will participate in the development of the work plan; development of the individual field sampling plans; and the field work, data analysis, report preparation, work plan modifications, and planning of subsequent investigations, as necessary.

The OU 1093 technical team requires these primary disciplines: hydrogeology, statistics, geochemistry, and health physics. The composition of the technical team may change with time as the technical expertise needed to implement the OU 1093 RFI changes.

5.7 Field Team Leader(s)

The field team leaders will implement work assignments in the field from the field teams manager. Each field team leader will direct the execution of field sampling activities, using crews of field team members as appropriate. Field team leaders may be contractor personnel.

5.8 Site Safety Officer(s)

The site safety officers observe, advise, and document the execution of the health and safety aspects of the OU 1093 work. They report any procedural violations to the health and safety project leader.

5.9 Field Team Member(s)

Field team members may include sampling personnel, geologists, hydrologists, health physicists, and other required disciplines.

All field team members require access to a site safety officer and a qualified field sampler. They are responsible for conducting the work detailed in field sampling plans, under the direction of the field team leaders. Field team members may be contractor personnel.

5.10 Data Analysis and Assessment Team

This team analyzes, or manages the analysis of, sample data. The team also assesses the sample results and requests additional samples, when appropriate.

6.0 PERSONNEL QUALIFICATIONS

The following personnel hold key positions in the development and implementation of the RFI work plan for OU 1093. Complete resumes for these individuals are available in the ER Program files.

T. E. (Gene) Gould - Operable Unit Project Leader

Mr. Gould holds a BA in history from New Mexico Institute of Mining and Technology (1972) and has earned graduate credits in accounting and business law from the College of Santa Fe. He has received additional training in program management planning and control, management skills development, and indirect cost accounting.

He has been employed at the Laboratory since May 1974, where he has held positions as assistant group leader for M-3 (Denotation Physics), assistant division leader for M-Division (Dynamic Testing), and technical coordinator for the Los Alamos ICF Program. He was appointed OUPL for OU 1093 in July 1991.

Merlin L. Wheeler - Work Plan Development Leader for OU 1093

Dr. Wheeler received a PhD from the University of Arizona in hydrology (1972), preceded by a MS in geology (1965) and a BS in mathematics (1962) from Michigan State University. He has received additional training in hazardous waste operations and emergency response.

Dr. Wheeler was employed at the Laboratory from 1973 to 1980, working on programs for improvement of radioactive waste management practices and development of environmental monitoring programs at waste disposal areas. From 1981 to 1990, he was employed by Los Alamos Technical Associates, Inc., working on and managing projects related to low-level and high-level radioactive waste management, hazardous waste management, development of environmental assessments and environmental impact statements, and site characterization at both hazardous and radioactive waste sites. These projects involved the development and analysis of data, including hydrologic and atmospheric transport modeling, to assess extent, mobility, transport, and impacts of radioactive and hazardous waste constituents. He has been employed by ICF Kaiser Engineers, in Los Alamos, New Mexico since October 1990. He has served as project manager for environmental characterization of a uranium mill site and provided assistance in the development and implementation of environmental monitoring programs. During his professional career, he has worked on numerous projects concerned with characterization (including sampling and analysis) of groundwater, surface water, soils, air, and biota.

Victor L. Hesch - Engineer

Mr. Hesch received a BS from the College of Santa Fe in general science (1964) and an MA in management from the University of Phoenix in 1989. He has received additional training in various aspects of engineering, including vacuum technology, modern techniques of machine design, and plutonium metallurgy.

Mr. Hesch has been employed at the Laboratory since 1966 beginning with the Engineering Support Group where he served as a design draftsman. From 1968 to 1971, he worked with a weapons group, GMX-3, providing design services for weapons and weapons testing equipment. From 1971 to 1973, he was employed by CMB-7, Chemistry and Metallurgy, where he performed stress calculations, designed mechanical and electro-mechanical systems, and reviewed engineering designs. From 1973 to 1984, he was a section leader with CHM-5, overseeing the engineering and design drafting department. He reviewed design drawings, interfaced with fabricators, and developed designs for optical, vacuum, mechanical, and electro-mechanical systems. Beginning in 1984 to the present, he was employed by MEE-4, serving as a senior designer in an electro-mechanical design section. He served as a lead designer for glove-box development for plutonium handling.

Peter Gram - Hydrogeologist

Mr. Gram received a BS in geology from The Colorado College (1985) and an MS in hydrogeology from Colorado State University (1992).

Mr. Gram was employed from 1985 to 1990 by Los Alamos Technical Associates, Inc. He contributed to a remedial investigation and cleanup at an in-situ uranium leaching site near Grants, New Mexico and assisted in the development of a portable water purification system. He has been employed by ICF Kaiser Engineers, in Los Alamos since 1990. He has participated in development of National Environmental Policy Act documentation for a hazardous and mixed waste treatment/disposal facility at the Laboratory, determined compliance status of various Laboratory groups with DOE orders, and has contributed to the development of RFI work plans for three operable units.

Wilette M. Wehner - Technical Editor

Ms. Wehner received a BA from Michigan State University in journalism (1972). She was employed by Los Alamos Technical Associates, Inc. from 1974 to 1981, where she provided technical editing on such projects as an Environmental Monitoring Plan for Argonne National Laboratory-East, Proceedings of a Workshop on Atmospheric Research Needs, report of the Lunar Base Working Group, and an environmental impact statement for Idaho National Engineering Laboratory. She has been employed by ICF Kaiser Engineers, in Los Alamos, since 1991. She edited and organized an Occurrence Reporting Handbook addressing compliance with DOE orders and is currently the technical editor for RFI work plans for OUs 1093 and 1100.

Charles Randall Mynard - Designer

Mr. Mynard received a BA from University of Texas at Austin in 1968 majoring in zoology with minors in chemistry and math. He has been employed by the Laboratory since January 1977, beginning with the Illustrations Group, ISD-3, where he provided technical illustrations for nuclear reactor designs, solar, and super-conducting power systems. He was hired by Weapons Planning and Coordination Group (WPC-1) in December 1978 to do illustrations for nuclear weapon design proposals. He joined WX-4, now Technical Engineering Support (MEE-4), in June 1980 to do complex engineering drawings, computer graphics, 35 mm photography, videotaping, and provide safety support services. As safety representative for MEE-4 since 1983, he plans, schedules, conducts, and documents the group's environmental, safety, and health (ES&H) program, which includes hazard assessment, safety inspections, audits, chemical inventory, chemical waste storage and disposal, hazard communication, ES&H training, and emergency planning. He is presently providing archival research, field surveys, photography, and graphics support services to the ER Program, working on OU 1093.

REFERENCES FOR ANNEX I

DOE (US Department of Energy), March 6, 1987. "Project Management System," DOE Order 4700.1, Washington, DC. (DOE 1987, 0069)

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

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

Annex II

Quality Assurance Project Plan

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SIGNATURE PAGE

Approval for Implementation

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

   SIGNATURE: ______________________ DATE: _______

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

   SIGNATURE: ______________________ DATE: _______

3. NAME: Craig Leasure
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   SIGNATURE: ______________________ DATE: _______

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

   SIGNATURE: ______________________ DATE: _______

5. NAME: Barbara Driscoll
   TITLE: Geologist, Region 6, Environmental Protection Agency

   SIGNATURE: ______________________ DATE: _______

6. NAME: Alva Smith
   TITLE: Chief of Office of Quality Assurance, Region 6, Environmental Protection Agency

   SIGNATURE: ______________________ DATE: _______

7. NAME: T. E. Gene Gould
   TITLE: Operable Unit Project Leader, Mechanical and Electrical Engineering Group (MEE-4), Los Alamos National Laboratory

   SIGNATURE: ______________________ DATE: _______

INTRODUCTION

This Quality Assurance Project Plan (QAPjP) for the RFI work plan for OU 1093 was written as a matrix report (Table II-1) based on the ER Program's generic QAPjP (LANL 1991, 0553).

The generic QAPjP describes the format for each operable unit's QAPjPs. In the generic QAPjP, Section 1 is the Signature Page, which is included in the front of this annex. Section 2 is a Table of Contents, which was omitted from this annex because the OU 1093 QAPjP is presented as a matrix. Section 3 is the Project Description and Subsection 3.1 is the Introduction. This introduction will serve as the equivalent of Subsection 3.1 and the matrix (Table II-1) will begin with Subsection 3.2, Facility Description.

The OU 1093 QAPjP matrix (Table II-1) appears as a table in which the generic QAPjP criteria are listed in the first column; these criteria correspond to the sections of the generic QAPjP. The second column lists the specific requirements of the generic QAPjP that the OU 1093 QAPjP must meet; the subsection titles and numbers in the second column correspond directly with those contained in the generic QAPjP. Sections of the generic QAPjP that do not contain specific requirements are not included in the matrix, e.g., Subsection 3.4. The third column lists the location of information in the IWP and/or the OU 1093 work plan that fulfills the requirements in the generic QAPjP. If OU 1093 will be following the requirements in the generic QAPjP, and no further information is necessary, the column will contain the phrase "generic QAPjP accepted." In some cases, a standard operating procedure (SOP) and/or a clarification note are included.

TABLE II-1

OU 1093 QAPjP MATRIX

Generic QAPjP Criteria	Generic QAPjP Requirements by Subsection	OU 1093 Incorporation of Generic QAPjP Requirements
Project Description	3.2 Facility Description	Los Alamos National Laboratory (LANL) ER Program IWP, Chapter 2, and OU 1093 work plan, Chapter 2
	3.3 ER Program	LANL ER Program IWP, Chapter 3.
	3.4.1 Project Objectives	OU 1093 work plan, Chapters 1 and 5.
	3.4.2 Project Schedule	OU 1093 work plan, Annex I.
	3.4.3 Project Scope	OU 1093 work plan, Chapters 1 and 5.
	3.4.4 Background Information	OU 1093 work plan, Chapters 1, 2, and 3.
	3.4.5 Data Management	OU 1093 work plan, Annex IV, and LANL ER Program IWP, Annex IV.
Project Organization	4.1 Line Authority	OU 1093 work plan, Annex I.
	4.2 Personnel Qualifications, Training, Resumes	OU 1093 work plan, Annex I, and ER Project Files.
	4.3 Organizational Structure	LANL-ER-QPP, Section 2, and OU 1093 work plan, Annex I. See **Note 1.**
Quality Assurance Objectives for Measurement Data in Terms of Precision, Accuracy, Representativeness, Completeness, and Comparability	5.1 Level of Quality Control	Generic QAPjP accepted.
	5.2 Precision, Accuracy, and Sensitivity of Analyses	Generic QAPjP accepted.
	5.3 QA Objectives for Precision	Generic QAPjP accepted.
	5.4 QA Objectives for Accuracy	Generic QAPjP accepted.
	5.5 Representativeness, Completeness, and Comparability	Generic QAPjP accepted.
	5.6 Field Measurements	Generic QAPjP accepted.
	5.7 Data Quality Objectives	OU 1093 work plan, Chapter 5.
Sampling Procedures	6 Sampling Procedures	OU 1093 work plan, Chapters 4 and 5, and ER Program SOPs.
	6.1 Quality Control Samples	Generic QAPjP accepted, including ER Program SOP-01.05.
	6.2 Sample Preservation During Shipment	Generic QAPjP accepted, including ER Program SOP-01.02.
	6.3 Equipment Decontamination	Generic QAPjP accepted, including ER Program SOP-01.06.
	6.4 Sample Designation	Generic QAPjP accepted, including ER Program SOP-01.04.
Sample Custody	7.1 Overview	Generic QAPjP accepted, including ER Program SOP-01.04.
	7.2 Field Documentation	Generic QAPjP accepted, including ER Program SOP-01.04.
	7.3 Sample Management Facility	Generic QAPjP accepted.
	7.4 Laboratory Documentation	Generic QAPjP accepted.

TABLE II-1 (concluded)

OU 1093 QAPjP MATRIX

Generic QAPjP Criteria	Generic QAPjP Requirements by Subsection	OU 1093 Incorporation of Generic QAPjP Requirements
	7.5 Sample Handling, Packaging, and Shipping	Generic QAPjP accepted, including ER Program SOP-01.03.
	7.6 Final Evidence File Documentation	Generic QAPjP accepted.
Calibrations Procedures and Frequency	8.1 Overview	Generic QAPjP accepted.
	8.2 Field Equipment	Generic QAPjP accepted.
	8.3 Laboratory Equipment	Generic QAPjP accepted.
Analytical Procedures	9.1 Overview	Generic QAPjP accepted.
	9.2 Field Testing and Screening	Generic QAPjP accepted, including ER Program SOP-06.02.
	9.3 Laboratory Methods	Most analytical methods in the QAPjP will be used, but some substitutions will occur where alternate methods are more cost effective. Sampling plans are described in OU 1093 work plan, Chapter 5.
Data Reduction, Validation, and Reporting	10.1 Data Reduction	Generic QAPjP accepted.
	10.2 Data Validation	Generic QAPjP accepted.
	10.3 Data Reporting	Generic QAPjP accepted.
Internal Quality-Controlled Checks	11.1 Field Sampling Quality Control Checks	Generic QAPjP accepted.
	11.2 Laboratory Analytical Activities	Generic QAPjP accepted.
Performance and System Audits	12 Performance and System Audits	Generic QAPjP accepted.
Preventive Maintenance	13.1 Field Equipment	Generic QAPjP accepted.
	13.2 Laboratory Equipment	Generic QAPjP accepted.
Specific Routine Procedures Used to Assess Data Precision, Accuracy, Representativeness, and Completeness	14.1 Precision	Generic QAPjP accepted.
	14.2 Accuracy	Generic QAPjP accepted.
	14.3 Sample Representativeness	Generic QAPjP accepted. See **Note 2**.
	14.4 Completeness	Generic QAPjP accepted
Corrective Action	15.1 Overview	Generic QAPjP accepted, including LANL-ER-QP-01.3Q.
	15.2 Field Correction Action	Generic QAPjP accepted.
	15.3 Laboratory Corrective Action	Generic QAPjP accepted.
Quality Assurance Reports to Management	16.1 Field Quality Assurance Reports to Management	Generic QAPjP accepted. See **Note 3**.
	16.2 Laboratory Quality Assurance Reports to Management	Generic QAPjP accepted.
	16.3 Internal Management Quality Assurance Reports	Generic QAPjP accepted.

Note 1: Section 4 - Project Organization and Responsibility

The organizational structure of the ER Program is presented in Chapter 2 of the LANL ER Quality Program Plan (QPP) to the Programmatic Project Leader (PPL) level, including quality assurance functions. Annex I of the OU 1093 work plan describes the organizational structure from the PL-level down and presents an organizational chart to demonstrate line authority.

Note 2: Subsection 14.3 - Sample Representativeness

The field sampling plans presented in Chapter 5 of the OU 1093 work plan were developed to meet the sample representativeness criteria described in Subsection 14.3 of the ER Program 's generic QAPjP (LANL 1991, 0553).

Note 3: Subsection 16.1 - Field Quality Assurance Reports to Management

The OU 1093 QA Officer, or designee, will provide a monthly field progress report to the ER Program Manager. This report will consist of the information identified in Subsection 16.1 of the ER Program's generic QAPjP (LANL 1991, 0553).

REFERENCES FOR ANNEX II

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

Annex III

Health and Safety Project Plan

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ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
ALARA	as low as reasonably achievable
AR	Administrative Requirement
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
EM	Environmental Management (Division)
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration (Program)
ERPG	Emergency Response Planning Guideline
ES&H	Environment, Safety, and Health
GET	General Employee Training
HAZWOP	Hazardous Waste Operations
HAZWOPER	Hazardous Waste Operations and Emergency Response
HSPL	Health and Safety Project Leader
IWPHSPP	Installation Work Plan, Health and Safety Program Plan
LP	Laboratory Procedure
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
OU	operable unit
OUHSP	Operable Unit Health and Safety Plan
OUPL	Operable Unit Project Leader
PC	protective clothing
PEL	permissible exposure limit
PPE	personal protective equipment
PRS	potential release site
RCRA	Resource Conservation and Recovery Act of 1976
SARA	Superfund Amendments and Reauthorization Act of 1986
SSHSP	Site-Specific Health and Safety Plan
SSO	Site Safety Officer
TLD	thermoluminescent dosimeter
TLV	threshold limit value

1.0 INTRODUCTION

1.1 Purpose

The purpose of this Operable Unit Health and Safety Plan (OUHSP) is to recognize potential safety and health hazards, describe techniques for their evaluation, and identify control methods. The goal is to eliminate injuries and illness; to minimize exposure to physical, chemical, biological, and radiological agents during environmental restoration (ER) activities; and to provide contingencies for events that may occur while these efforts are under way.

It is intended that project managers, health and safety professionals, laboratory managers, and regulators use this OUHSP as a reference for information about health and safety programs and procedures as they relate to this operable unit (OU). OU specific information can be found in sections 3 and 4 of this document. The other sections of this document contain general information applicable to all OUs. Detailed Site-Specific Health and Safety Plans (SSHSPs) and procedures will be prepared subsequent to this document.

The Health and Safety Division Hazardous Waste Operations (HAZWOP) Program establishes laboratory policies for health and safety activities at ER sites. The hierarchy of health and safety documents for the Los Alamos National Laboratory (the Laboratory) ER Program is as follows:

1. Installation Work Plan, Health and Safety Program Plan (IWPHSPP)
2. OUHSP
3. SSHSP

The first document is more general, while the others become increasingly more specific and detailed. While each document is written so it can stand alone, the contents and references to these and other documents should always be considered when making decisions.

1.2 Applicability

These requirements apply to all personnel at ER sites, including Laboratory employees, supplemental work force personnel, regulators, and visitors. There are no exceptions.

1.3 Regulatory Requirements

Government-owned, contractor-operated facilities must comply with Occupational Safety and Health Administration (OSHA), U.S. Environmental Protection Agency (EPA) regulations, and U.S. Department of Energy (DOE) orders. The following is a brief synopsis of hazardous waste-related requirements.

The first federal effort to address hazardous waste problems followed the passage of the Resource Conservation and Recovery Act of 1976 (RCRA).

RCRA mandated the development of federal and state programs for the disposal and resource recovery of waste materials. RCRA regulates generation, treatment, storage, disposal, and transportation of hazardous waste.

Historically, there were many hazardous waste sites abandoned. Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, commonly known as "Superfund" to clean up and reclaim these sites.

The treatment and disposal of hazardous wastes posed health and safety risks to the workers engaged in these operations. These risks and the need for protecting workers engaged in hazardous waste site operations are addressed in the Superfund Amendments and Reauthorization Act of 1986 (SARA).

Under SARA, the Secretary of Labor is required to promulgate worker protection regulations. After consulting with many organizations, including EPA, OSHA, the U.S. Coast Guard, and the National Institute for Occupational Safety and Health (NIOSH), a set of regulations was published in March 1989. This is 29 Code of Federal Regulations (CFR) Part 1910.120, Hazardous Waste Operations and Emergency Response (HAZWOPER).

DOE Orders 5480.4 and 5483.1A require DOE employees and contractors to comply with federal OSHA regulations. DOE 5480.11 sets radiation protection standards for all DOE activities. The DOE Radiological Control Manual established practices for the conduct of radiological control activities at all DOE sites and is used by DOE to evaluate contractor performance.

Laboratory Director's policies "Environment, Safety, and Health" and "Environmental Protection and Restoration," both dated September 1991, require compliance with federal regulations, DOE orders, and state and local laws.

1.4 Variances From Health and Safety Requirements

When special conditions exist, the Site Safety Officer (SSO) may submit to the Health and Safety Project Leader (HSPL) a written request for variance from a specific health and safety requirement. If the HSPL agrees with the request, it will be reviewed by the Operable Unit Project Leader (OUPL) or a designee. Higher levels of management may be consulted as appropriate. The condition of the request will be evaluated, and if appropriate, the HSPL will grant a written variance specifying the conditions under which the requirements may be modified. The variance will become part of the SSHSP.

1.5 Review and Approval

This document will be effective after it has been reviewed and approved by the appropriate Laboratory subject matter experts. Signatures of approval are required.

This document will be revised at least annually. Revisions will reflect changes in the scope of work, site conditions, work procedures, site data, contaminant monitoring, or visual information technology, policies, and/or procedures. Changes must be approved by the HSPL and OUPL. A complete review will be conducted should feasibility studies or remediation be necessary.

2.0 ORGANIZATION, RESPONSIBILITY, AND AUTHORITY

This section describes the general and individual responsibilities for health and safety, roles in field organization, and organizational structure. The health and safety oversight mechanism is also provided.

2.1 General Responsibilities

The Laboratory's Environment, Safety, and Health (ES&H) Manual delineates managers' and employees' responsibilities for conducting safe operations and providing for the safety of contract personnel and visitors. The general safety responsibilities for ER activities are summarized in the IWPHSPP. Line Management is responsible for implementing health and safety requirements.

An individual observing an operation that presents a clear and imminent danger to the environment or to the safety and health of employees, subcontractors, visitors, or the public has the authority to initiate a stop-work action. The requirements, responsibilities, and basis for stop-work actions and for restarting activities is established in Laboratory Procedure (LP) 116-01.0. Any individual observing or performing operations that meet the criteria for stop-work actions shall follow the procedural steps as described in LP 116-01.0. Those with stop-work authority include employees, subcontractors, or visitors performing the affected work, ES&H discipline experts, and line managers responsible for the operation. Any other individual that observes work being performed by another individual that presents a clear and imminent danger shall follow reporting requirements as specified in LP 116-01.0. Upon initiation of stop-work actions, related activities are documented on the Stop-Work Report Form and the log for Stop-Work Reports.

Personnel conducting work for the ER Program shall comply with the Laboratory's stop-work policy and the requirements of LP 116-01.0. In addition, upon initiation of stop-work actions, ER Program personnel shall notify the SSO, the ER Program HSPL, and the OUPL.

2.1.1 Kick-Off Meeting

A health and safety kick-off meeting will be held before field work begins. The purpose of the meeting is to reach a consensus on responsibility, authority, lines of communication, and scheduling. The HSPL will organize the meeting and has the authority to delay field work until the kick-off meeting is held.

2.1.2 Readiness Review

A field readiness review must be completed by the OUPL before field activities begin. The HSPL is responsible for approving the health and safety section of the readiness review.

2.2 Individual Responsibilities

Laboratory employees and supplemental work force personnel are responsible for health and safety during ER Program activities. Figure III-1 illustrates the field work organizational chart, showing the line organization.

2.2.1 Environmental Management and Health and Safety Division Leaders

The Environmental Management (EM) and Health and Safety Division Leaders are responsible for addressing programmatic health and safety concerns. They shall promote a comprehensive health and safety program that includes radiation protection, occupational medicine, industrial safety, industrial hygiene, criticality safety, waste management, and environmental protection and preservation.

2.2.2 Environmental Restoration Program Manager

The ER Program Manager (EM-13) is responsible for implementing the overall heath and safety program plan. The program manager provides for the establishment, implementation, and support of health and safety measures.

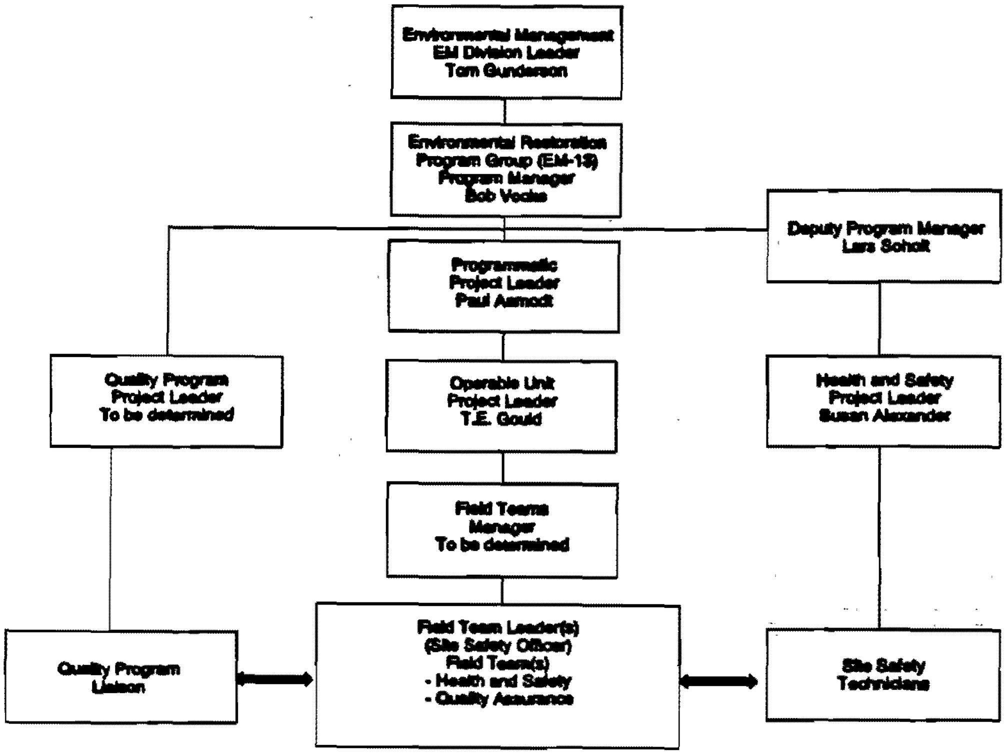

Figure III-1. OU field work organizational chart.

2.2.3 Health and Safety Project Leader

The HSPL is responsible for preparing and updating the IWPHSPP. The HSPL helps the OUPL in identifying resources to be used for the preparation and implementation of the OUHSP. Final approval of the IWPHSPP, OUHSP, and SSHSP is the responsibility of the HSPL. In conjunction with the field team leaders, the HSPL oversees daily health and safety activities in the field, including scheduling, tracking deliverables, and resource utilization.

2.2.4 Operable Unit Project Leader

The OUPL is responsible for all investigation activities for his/her assigned OU. Specific health and safety responsibilities include:

- preparing, reviewing, implementing, and revising OUHSPs;
- interfacing with the HSPL to resolve health and safety concerns; and
- notifying the HSPL of schedule and project changes.

2.2.5 Operable Unit Field Team Leader

The OU field team leader is responsible for:

- scheduling tasks and manpower,
- conducting site tours,
- overseeing engineering and construction activity at the sites, and
- overseeing waste management.

2.2.6 Field Team Leader

The field team leader is responsible for implementing the sampling and analysis plan, the OUHSP, and the project-specific Quality Assurance Project Plan (Annex II). He/she may also serve as the SSO. Safety responsibilities include:

- ensuring the health and safety of field team members,
- implementing emergency response procedures and fulfilling notification requirements, and
- notifying the HSPL of schedule changes.

2.2.7 Site Safety Officer

An SSO other than the field team leader may be assigned depending on the potential hazards. Contractors must assign their own SSO.

The SSO is responsible for ensuring that trained and competent personnel are on-site. This includes industrial hygiene and health physics technicians and first aid/cardiopulmonary resuscitation responders. The SSO may fill any or all of these roles.

The SSO has the following responsibilities:

- advising the HSPL and OUPL of health and safety issues;
- performing and documenting initial inspections for all site equipment;
- notifying proper Laboratory authorities of injuries or illnesses, emergencies, or stop-work orders;
- evaluating the analytical results for health and safety concerns;
- determining protective clothing (PC) requirements;
- inspecting PC and equipment;
- determining personal dosimetry requirements for workers;
- maintaining a current list of telephone numbers for emergency situations;
- providing an operating radio transmitter/receiver if necessary;
- maintaining an up-to-date copy of the SSHSP for work at the site;
- controlling entry and exit at access control points;
- establishing and enforcing the safety requirements to be followed by visitors;
- briefing visitors on health and safety issues;
- maintaining a logbook of workers entering the site;

- determining whether workers can perform their jobs safely under prevailing weather conditions;
- monitoring work parties and conditions;
- controlling emergency situations in collaboration with Laboratory personnel;
- ensuring that all personnel are trained in the appropriate safety procedures and are familiar with the SSHSP and that all requirements are followed during OU activities;
- conducting daily health and safety briefings for field team members;
- stopping work when unsafe conditions develop or an imminent hazard is perceived;
- inspecting to determine whether SSHSP is being followed; and
- maintaining first aid supplies.

2.2.8 Field Team Members

Field team members are responsible for following safe work practices, notifying their supervisor or the SSO if unsafe conditions exist, and immediately reporting any injury, illness, or unusual event that could impact the health and safety of site personnel.

2.2.9 Visitors

Site access will be controlled so that only verified team members and previously approved visitors will be allowed in work areas or areas containing potentially hazardous materials or conditions. Special passes or badges may be issued. There are two types of visitors: those that collect samples and those who do not.

Any visitors who are on-site to collect samples or split samples must meet all the health and safety requirements of any field sampling team for that site. Visitors must comply with the provisions of the SSHSP and sign an acknowledgement agreement to that effect. In addition, visitors will be expected to comply with relevant OSHA requirements, such as medical monitoring, training, and respiratory protection.

The following rules govern the conduct of site visitors who will not be collecting samples. The site visitor will:

1. Report to the SSO upon arrival at the site.
2. Login/logout upon entry/exit to the site.
3. Receive abbreviated site training from the SSO on the following topics:
    - site-specific hazards,
    - site protocol,
    - emergency response actions, and
    - muster areas.
4. Not be permitted to enter the exclusion zone.
5. Receive escort from SSO or other trained individuals at all times.

If a visitor does not adhere to these requirements, the SSO will request the visitor to leave the site. All nonconformance incidents will be recorded on the site log.

2.2.10 Supplemental Work force

All supplemental work force personnel performing site investigations will be responsible for developing health and safety plans that cover their specific project assignments. As a minimum, the plans shall conform to the requirements of this OUHSP. Deficiencies in health and safety plans will be resolved before the contractor is authorized to proceed.

Contractors will adhere to the requirements of all applicable health and safety plans. Laboratory personnel will monitor activities to ensure that this is done. Failure to adhere to these requirements can cause work to stop until compliance is achieved.

Contractors will provide their own health and safety functions unless other contractual agreements have been arranged. Such functions may include, but are not limited to, providing qualified health and safety officers for site work, imparting a corporate health and safety environment to their employees, providing calibrated industrial hygiene and radiological monitoring equipment, enrolling in an approved medical surveillance program, supplying approved respiratory and personal protective equipment (PPE), providing safe work practices, and training hazardous waste workers.

2.3 Personnel Qualifications

The HSPL will establish minimum training and competency requirements for on-site personnel. These requirements will meet or exceed 29 CFR 1910.120 regulations.

2.4 Health and Safety Oversight

Oversight will be maintained to ensure compliance with regulatory requirements. The Health and Safety Division is responsible for developing and implementing the oversight program. The frequency of field verifications will depend on the characteristics of the site, the equipment used, and the scope of work.

2.5 Off-Site Work

The HSPL and OUPL will review health and safety requirements and procedures for off-site work. Alternate approaches may be used if they are in the best interest of the public and the Laboratory; they will be handled on a case-by-case basis.

3.0 SCOPE OF WORK

3.1 Comprehensive Work Plan

The IWPHSPP for ER targets OU 1093 for investigation. The initial phase is investigation and characterization, involving environmental sampling and field assessment of the areas. This OUHSP addresses the tasks in the Phase I study. Tasks for additional phases will be addressed in revisions to this document.

3.2 Operable Unit Description

OU 1093 consists of 53 potential release sites (PRSs). These include solid waste management units and areas of concern. Thorough descriptions and histories of these sites can be found in Section 5 of the Work Plan. The following is a list of the PRS aggregates. Table III-1 summarizes the PRSs, the potential hazards, and the work planned at this time.

1. Aggregate A for TA 18—Liquid waste management systems
2. Aggregate B—Underground storage tank
3. Aggregate C for TA 18 and 27—Inactive firing sites, magazine site, and generator site
4. Aggregate D for TA 18—Storm sewer/outfalls
5. Aggregate E for TA 18 and 27—Materials disposal area and bazooka impact area

Table III-1. Summary of PRSs, OU 1093

Description	Tasks	Chemicals of concern	Radionuclides of concern
Aggregate A for TA 18-Liquid waste management systems	Liquid, sludge and soil sampling	Solvents, acids, photoprocessing chemicals, beryllium	Uranium, plutonium
Aggregate B-Underground storage tank	Excavation, soil sampling, tank removal	Diesel fuel(petroleum hydrocarbons)	None anticipated
Aggregate C for TA 18 and 27-Inactive firing sites, magazine site, and generator site	Surface soil sampling	High explosive residuals, lead, beryllium, beryllium oxide, mercury	Uranium, thorium
Aggregate D for TA 18-Storm sewer/outfalls	Sediment sampling	Lead, solvents	Uranium
Aggregate E for TA 18 and 27-Materials disposal area and bazooka impact area	Geophysical survey	Munitions	Uranium

4.0 HAZARD IDENTIFICATION AND ASSESSMENT

The SSO or designee will monitor field conditions and personnel exposure to physical, chemical, biological, and radiological hazards. If a previously unidentified hazard is discovered, the SSO will contact the field team leader and the HSPL and assess the hazard. A hazard assessment will be performed to identify the potential harm, the likelihood of occurrence, and the measures to reduce risk. The assessment will be documented, reviewed, and approved by the HSPL and OUPL. Appropriate field team leaders and field team members will receive copies of the assessment, and it will be discussed in a tailgate meeting or other appropriate forum. The approved assessment will be added to this plan as an amendment.

4.1 Physical Hazards

Injuries caused by physical hazards are preventable. Some physical hazards such as open trenches, loud noise, and heavy lifting are easily recognized. Others, such as heat stress and sunburn, are less apparent. The purpose of this section is to list some anticipated physical hazards. These hazards are listed because they often occur during these types of ER activities. Some, such as altitude sickness, are more unique. For these unique physical hazards, a brief discussion is provided. For other, more common hazards, no detailed discussion is provided. Detailed information about these potential hazards can be found in Health and Safety Division HAZWOP Program documentation or almost any industrial hygiene reference book (e.g., *Fundamentals of Industrial Hygiene*, 1988).

Table III-2 lists some of the anticipated physical hazards representative of the types of hazards inherent to ER work. It is not inclusive. If additional physical hazards are identified, they will be added to this table by the SSO.

4.1.1 High Explosives

Areas that may contain high explosives will be clearly identified. Materials should not be handled without proper authorization from the explosives safety expert. The following precautions will be taken with respect to explosive hazards while conducting field work:

Table III-2. Physical hazards of concern, OU 1093

Hazard description	PPE	Prevention methods	Monitoring methods
Noise	Ear plugs and muffs	Engineering controls, mufflers, noise absorbers, PPE	Sound level meter, noise dosimeter
Vibration	Gloves, absorbing materials	Prevention or attenuation, isolation, increasing distance from source	Accelerometers and mechanoelectrical transducers with electronic instrumentation
Energized equipment	Gloves, safety shoes, safety glasses	Lockout/tagout of equipment	Circuit test light/meter, grounding stick
Confined space entry	Gloves, boots, full-body suit, supplied-air or self-contained breathing apparatus, safety glasses, lifeline	Ventilation, oxygen, combustible gas monitoring, following procedure	Combustible gas meter, oxygen monitors
Trenching	Hard hats, safety shoes, safety glasses	Protective shoring, proper excavation access, egress	Visual, oxygen meter, determining soil type
Fire/Explosion	Hard hat, gloves, face shield, fire-resistant full-body suit	Ventilation, containment of fuel source, isolation/insulation from ignition source or heat	Combustible gas meter
High explosives	Latex gloves, safety glasses, blast shields	Identification of contaminated areas, field screening, following procedures	Visual inspection, screening tests
Welding/Cutting/ Brazing	Fire-resistant gloves and clothing (aprons, coveralls, leggings), welding helmets or goggles	Ventilation, PPE	Personal sampling for metal fumes

Table III-2 (continued)

Hazard description	PPE	Prevention methods	Monitoring methods
Compressed gas cylinders	Face shield, safety shoes, gloves	PPE. Cylinders should be stored in areas protected from weather. Cylinders should be secured and stored with protective caps in place. Regulators are not to be left on stored cylinders.	Visual, combustible gas meter, photoionization detector
Material handling	Hard hat, safety shoes, gloves	Lifting aids, correct lifting procedure, work/rest periods	Weigh or estimate weight of typical materials and set limits for lifting
Walking/Working surfaces	Safety shoes	Clean and dry surfaces, nonskid surfacing material	Visual inspection
Machine guarding	Face shield, gloves, safety shoes	Guard interlocks, maintain guards in good condition	Visual monitoring, observation of work practices
Motor vehicle accidents	Seat belt	Defensive driving training, reduced speed during adverse conditions	Observation of work practices
Heavy equipment	Hard hat, safety shoes, gloves	Operator training. Stay clear of energized sources	Observation of work practices
Heat stress	Hat, cooling vest	ACGIH work/rest regimens	Wet bulb globe thermometer
Cold stress	Hat, gloves, insulated boots, coat, face protection	ACGIH work/warm-up schedule, heated shelters	Thermometer and wind speed measurement, wind chill chart
Sunburn	Hat, safety sunglasses, full-body protection	Cover body with clothing or sunscreen	Solar load chart
Altitude sickness	None	Acclimatization ascent/descent schedule	Self-monitoring for symptoms
Lightning	None	Grounding all equipment, stop work during thunderstorms and seek shelter	Weather reports and visual observation

Table III-2 (continued)

Hazard description	PPE	Prevention methods	Monitoring methods
Flash floods	None	Seek shelter on high ground	Weather reports and visual observation

PPE = Personal Protective Equipment

1. The location will be monitored before sampling with an appropriate radiation detection and/or organic vapor monitor.
2. The ground will be sprayed or saturated with water before sampling to minimize the potential for sparks or particulate dispersion.
3. A nonsparking sampling device will be pushed into the ground with a minimum amount of turning during surface sampling.
4. All samples will contain at least 10% moisture before being sealed in containers.
5. All samples will be screened by trained personnel using high explosives screening procedures as described in LANL Safety Procedures for field work in Explosive Areas. The SSO will ensure that contractor procedures are equivalent to LANL high explosives procedures.
6. Sample containers will be shipped in paint cans padded with vermiculite and placed in a cooler with ice packs.
7. Samples will be handled only in well-ventilated areas, and their exposure to light and heat will be minimized.
8. Latex gloves and safety glasses will be worn during sample collection.
9. The skin will be washed thoroughly with soap and water immediately after accidental contact.

Field personnel will not handle any material in the area unless directed by the sampling plan. This precaution will prevent contact with any high explosive fragments present in the area. Material with blue, pink, red, yellow, green, white, or orange coloration could be indicative of high explosive material.

If noticeable surface or buried high explosive residues or fragments are encountered in the immediate vicinity of a drilling location, drilling will be halted. Sample collection will continue only if a blast shield is installed or if a backhoe is used to obtain samples. This decision will be made by the field team leader and the SSO. The HSPL shall be notified before resuming field activities.

4.1.2 Altitude Sickness

Individuals coming to the Laboratory from lower elevations may experience altitude sickness. Workers coming from sea level and who are expected to perform heavy physical labor may be at highest risk. Recognition of individual risk factors and allowance for acclimatization are the keys to prevention.

At higher altitude, atmospheric pressure is reduced. There are a smaller number of oxygen molecules per unit volume and the partial pressure of oxygen is lower. A unit of work, whether performed at altitude or sea level, requires the same amount of oxygen. Oxygen flow to body tissues must remain constant to maintain that level of work. Increased respiration and cardiovascular response can only partially compensate for these factors in individuals suddenly placed at high altitude.

The factors playing a part in determining working capacity at altitude are:

- actual height (low, moderate, high altitude)
- duration of exposure
- individual factors

The Laboratory's moderate altitude (approximately 7,500 feet) will probably have an effect on prolonged endurance for unacclimatized individuals. At this level, acclimatization should be rapid (one or two weeks). Duration of exposure will dictate whether persons have an opportunity to acclimate or not. Individuals working on short-term assignments of less than two weeks will probably not acclimate.

It is not anticipated that work will require ascents of more than 200 to 300 feet at any time. Thus, too rapid ascension to high altitudes should not be a problem. It is assumed that all workers will be enrolled in a medical surveillance program. This will help identify individuals who may have existing conditions, such as respiratory or cardiovascular disease, that would put them at higher risk of altitude sickness. Each individual will adapt at a slightly different rate, but in about two weeks the impact of altitude on work capacity should be minimal.

4.2 Chemical Hazards

This section identifies and provides information on chemical contaminants that are known or are suspected to be present at this OU. When unknowns are identified, they will be added to the plan's list of chemical contaminants of concern. The SSO will be responsible for adding chemicals to this table and notifying field personnel as needed.

The SSHSP will provide information for known contaminants, which will include: American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV), immediately dangerous to life and health concentrations, exposure symptoms, ionization potential and relative response factor for commonly used instruments (re-evaluated when the particular instrument is selected), and the best instrument for screening.

Table III-3 lists the chemical contaminants of concern. This table should be used for general recognition of the chemicals to which workers may be exposed. More detailed information should be obtained from reliable references, such as *Patty's Industrial Hygiene and Toxicology* (1981).

4.3 Radiological Hazards

The principal pathways by which individuals may be exposed to radioactivity during field investigations include:

- inhalation or ingestion of radionuclide particles or vapors,
- dermal absorption of radionuclide particulates or vapors through wounds,
- dermal absorption through intact skin, and
- exposure to direct gamma radiation from contaminated materials.

Table III-4 provides the specific properties of the radionuclides of concern in this OU, including type of emission and half-life. As concentrations of these radionuclides are determined and additional radionuclides identified, the table will be updated. The SSO will be responsible for adding radionuclides to this table and notifying field personnel as needed.

Table III-3. Chemical contaminants of concern*

Contaminant	Exposure limit (8-hour TWA)	IDLH	Symptoms of exposure	Route(s) of exposure	Monitoring instrument	
					Direct reading	Indirect method
Acetone	750 ppm	20,000 ppm	Irritation of eyes, nose, and throat; dermatitis; dizziness	Inhalation, ingestion, skin contact	PID, FID, detector tube	Charcoal tube, GC, NIOSH Method 1300
Beryllium	0.002 mg/m^3 0.005 mg/m^3 - ceiling 0.025 mg/m^3 - 30 min maximum peak	Ca	Dermatitis, pneumonitis dyspnea, chronic cough, weight loss, weakness, chest pain	Inhalation, ingestion, skin contact	None	MCEF, AA, NIOSH Method 7102
Hydrochloric acid	5 ppm - ceiling	100 ppm	Inflamed nose, throat, cough, burns throat, choking, burns eyes and skin	Inhalation, ingestion, skin contact	Detector tube	Silica gel tube, Ion Chromatography, NIOSH Method 7903
Lead	0.05 mg/m^3	700 mg/m^3	Weakness, insomnia, constipation, malnutrition, abdominal pain, tremor, anorexia, anemia, face pallor, encephalopathy	Inhalation, ingestion, skin contact	None	MCEF, AA, NIOSH Method 7082
Mercury	0.05 mg/m^3 (skin)	None	Mercury vapor, cough, chest pains, tremor, insomnia, weakness, excessive salivation, dizziness, nausea, vomiting, constipation, irritated eyes and skin	Inhalation, ingestion, skin contact	Mercury vapor meter, detector tube	GFF + silvered Chromosorb P tube, AA, NIOSH Method 6000
Methyl ethyl ketone	300 ppm - STEL	3,000 ppm	Eye, nose, throat irritation; headache, dizziness; vomiting	Inhalation, ingestion, skin contact	PID, FID, detector tube	Ambersorb tube, GC, NIOSH Method 2500
Methylene chloride	50 ppm	Ca	Eye, nose, throat irritation, headache, stupor, fatigue, weakness, sleepiness, lightheadness, numb limbs; tingling, nausea	Inhalation, ingestion, skin contact	Detector tube	Charcoal tube, GC, NIOSH Method 1005

Table III-3 (continued)

Contaminant	Exposure limit (8-hour TWA)	IDLH	Symptoms of exposure	Route(s) of exposure	Monitoring instrument	
					Direct reading	Indirect method
Nitric acid	2 ppm, 4 ppm - STEL	100 ppm	Irritated eyes, mucus membranes, and skin; delayed pulmonary edema, pneumonitis, bronchitis; dental erosion	Inhalation, absorption, ingestion, skin contact	Detector tube	Silica gel tube, ion chromatography, NIOSH Method 7903
Photographic processing chemicals	Varies	Varies	A variety of chemicals are used in this process	Refer to Appendix 2	Varies	Varies
Silver	0.01 mg/m^3	None	Nasal septum, throat, and skin irritation; skin ulceration, gastrointestinal irritation, blue-gray eyes and patches on skin	Inhalation, ingestion, skin contact	None	MCEF, ICP, NIOSH Method 7300
Toluene	100 ppm, 150 ppm - STEL	2,000 ppm	Fatigue, weakness, confusion, euphoria, dizziness, headache, dilated pupils, lacrimation, nervousness, muscle fatigue, insomnia, paresthesia, dermatitis	Inhalation, ingestion, skin contact	PID, FID, detector tube	Charcoal tube, GC, NIOSH Method 1501

*High explosives of concern will be added to this table.

AA = atomic absorption
Ca = potential human carcinogens
FID = flame ionization detector
GC = gas chromatograph
GFF = glass fiber filter
ICP = inductively coupled plasma
IDLH = immediately dangerous to life and health

MCEF = mixed cellulose ester filter
NIOSH = National Institute for Occupational Safety and Health
PID = photoionization detector
STEL = short-term exposure limit
TWA = time-weighted average
ppm = parts per million
mg/m^3 = milligrams per cubic meter of air

Table III-4. Radionuclides of concern

Radionuclide	Major radiation	DAC (μCi/mL)	Radioactive half-life (years)	Monitoring instrument
Plutonium-238	Alpha, gamma	3×10^{-12}	87.7	Alpha scintillometer, FIDLER
Plutonium-239	Alpha, gamma	2×10^{-12}	2.4×10^{4}	Alpha scintillometer, FIDLER
Thorium-230	Alpha, gamma	4×10^{-14}	8×10^{4}	Alpha scintillometer, FIDLER
Uranium-233	Alpha, gamma	4×10^{-12}	1.6×10^{5}	Alpha scintillometer, FIDLER
Uranium-234	Alpha, gamma	4×10^{-12}	2.5×10^{5}	Alpha scintillometer, FIDLER
Uranium-235	Alpha, gamma	2×10^{-11}	7×10^{8}	Alpha scintillometer, FIDLER
Uranium-238	Alpha, gamma	2×10^{-11}	4.5×10^{9}	Alpha scintillometer, FIDLER
Polonium-210	Alpha, gamma	3×10^{-10}	138.4 days	Alpha scintillometer

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

4.4 Biological Hazards

There are several biological hazards found at Los Alamos that are not common in other parts of the country. These include, but are not limited to: rattlesnakes, wild animals, ticks, plague, giardia lamblia, and black widow spiders. Table III-5 summarizes some of the potential biological hazards for this OU.

4.5 Task-by-Task Risk Analysis

A task-by-task risk analysis is required by 29 CFR 1910.120 and will be included with each SSHSP. This process analyzes the operations and activities for specific hazards by task. Examples of some of the tasks that should be analyzed and documented in the SSHSP are:

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

Other tasks should be considered for inclusion by the SSO.

Table III-5. Biological hazards of concern, OU 1093

Hazard description	PPE	Prevention methods
Snake bites (rattlesnake)	Long pants, snake leggings, boots	Wear PPE where footing is difficult to see. Avoid blind reaches
Animal bites (dog, cat, coyote, mountain lion, bear)	Long pants, boots	Avoid wild or domestic animals; do not approach or attempt to feed
Ticks (may cause Lyme disease or tick fever)	Long pants, long-sleeved shirts, boots	Perform tick inspections of team members after working in brushy or wooded areas
Rodents (prairie dogs and squirrels may carry plague-infected fleas)	Long pants, boots	Do not handle live or dead rodents
Human sewage (may contain pathogenic bacteria)	Disposable coveralls and gloves	When sampling in septic systems, wear protective gear and dispose of properly. Wash hands thoroughly after contact
Bloodborne pathogens (blood, blood products, and human body fluids may contain Hepatitis B virus or HIV)	Latex gloves, mouthguards, protective eyewear	Only trained personnel should perform first aid procedures. Follow laboratory bloodborne pathogen control procedures
Poisonous plants (poison ivy)	Gloves, long pants, long-sleeved shirts, boots	Recognize plants, avoid contact, wash hands and garments thoroughly after contact
Waterborne infectious agents (stream water may contain giardia lamblia)	None	Drink water only from potable sources
Spiders (brown recluse, black widow)	Gloves, long pants, long-sleeved shirt, boots	Use caution when in wood piles or dark, enclosed places

5.0 SITE CONTROL

5.1 Initial Site Reconnaissance

Initial site reconnaissance may involve surveyors, archaeologists, biological resource personnel, etc. Health and safety concerns that may be present must be addressed to protect personnel. The OUPL and HSPL will identify these concerns and institute measures to protect environmental impact assessment personnel.

5.2 Site-Specific Health and Safety Plans

Each field event within an OU requires an SSHSP. Planning, special training, supervision, protective measures, and oversight needs are different for each event, and the SSHSP addresses this variability.

The OUHSP provides detailed information to project managers, Laboratory managers, regulators, and health and safety professionals about health and safety programs and procedures as they relate to an OU. The SSHSP addresses the safety and health hazards of each phase of site operations and includes requirements and procedures for employee protection. All SSHSPs in that OU derive from the OUHSP.

The standard outline for an SSHSP follows OSHA requirements and serves as a guide for best management practice. Those performing the field work are responsible for completing the plan.

Changes to the SSHSP must be made in writing. The HSPL shall approve changes, and site personnel shall be updated through daily tailgate meetings. Records of SSHSP approvals and changes will be maintained by the SSO.

5.3 Work Zones

Maps identifying work zones will be included with each SSHSP. Markings used to designate each zone boundary (red or yellow tape, fences, barricades, etc.) will be discussed in the plan. Evacuation routes should be upwind or crosswind of the exclusion zone. A muster area must be designated for each evacuation route.

Discrete zones are not required for every field event. The SSO will determine work zones. The following sections discuss the work zones.

- **Exclusion zone.** The exclusion zone is the area where contamination is either known or likely to be present or, because of work activities, will present a potential hazard to personnel. Entry into the exclusion zone requires the use of PPE.
- **Decontamination zone.** The decontamination zone is the area where personnel conduct personal and equipment decontamination. This zone provides a buffer between contaminated areas and clean areas. Activities in the decontamination zone require the use of PPE as defined in the decontamination plan.
- **Support zone.** The support zone is a clean area where the chance to contact hazardous materials or conditions is minimal. PPE other than safety equipment appropriate to the tasks performed (e.g., safety glasses, protective footwear, etc.) is not required.

5.4 Secured Areas

Secured areas shall be identified and shown on the site maps. Procedures and responsibilities for maintaining secured areas must be described. Standard Laboratory security procedures should be followed for accessing secure areas. All contractors and visitors must be processed through the badge office before entering secure areas. It is the responsibility of the OUPL to see that contractor personnel have badges. It is the responsibility of all Laboratory employees to enforce security measures.

5.5 Communications Systems

Portable telephones, CB radios, and two-way radios may be used for on-site communications. This type of equipment must not be used in areas where there may be high explosives; hand signals and verbal communications should be used in these areas.

5.6 General Safe Work Practices

Workers will be instructed on safe work practices to be followed when performing tasks and operating equipment needed to complete the project. Daily safety tailgate meetings will be conducted at the beginning of the shift to brief workers on proposed activities and special precautions to be taken.

The following items are requirements necessary to protect field workers and will be reiterated in SSHSPs. Depending on site-specific conditions, items may be added or deleted.

- The buddy system will be used. Hand signals will be established and used.
- During site operations, each worker should be a safety backup to his/her partner. All personnel should be aware of dangerous situations that may develop.
- Visual contact must be maintained between buddies on-site.
- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of potentially contaminated material is prohibited in any area designated as contaminated.
- Prescription drugs should not be taken by personnel where the potential for contact with toxic substances exist, unless specifically approved by a qualified physical.
- Alcoholic beverage intake is prohibited during the work day.
- Disposable clothing will be used whenever possible to minimize the risk of cross-contamination.
- The number of personnel and equipment in any contaminated area should be minimized, but effective site operations must be allowed for.
- Staging areas for various operational activities (equipment testing, decontamination, etc.) will be established.
- Motorized equipment will be inspected to ensure that brakes, hoists, cables, and other mechanical components are operating properly.
- Procedures for leaving any contaminated area will be planned and reviewed before entering these areas.

- Work areas and decontamination procedures will be established based on prevailing site conditions and will be subject to change.
- Wind direction indicators will be strategically located on-site.
- Contact with contaminated or potentially contaminated surfaces should be avoided. Whenever possible, do not walk through puddles, mud, or discolored ground surface; do not kneel on the ground or lean, sit, or place equipment on drums, containers, vehicles, or on the ground.
- No personnel will be allowed to enter the site without proper safety equipment.
- Proper decontamination procedures will be followed before leaving the site, except in medical emergencies.
- Any medical emergency supersedes routine safety requirements.
- Housekeeping will be emphasized to prevent injury from tripping, falling objects, and accumulation of combustible materials.
- All personnel must comply with established safety procedures. Any staff member or visitor who does not comply with safety policy, as established by the Field Safety Coordinator, will be immediately dismissed from the site.

5.7 Specific Safe-Work Practices

5.7.1 Electrical Safety-Related Work Practices

The most effective way to avoid accidental contact with electricity is to de-energize the system or maintain a safe distance from the energized parts/line. OSHA regulations require minimum distances from energized parts. An individual working near power lines must maintain at least a 10 foot clearance from overhead lines of 50 kilovolts (kV) or less. The clearance includes any conductive material the individual may be using. For voltages over 50 kV, the 10 foot clearance must be increased 4 inches for every 10 kV over 50 kV.

5.7.2 Grounding

Grounding is a secondary form of protection that ensures a path of low resistance to ground if there is an electrical equipment failure. A properly installed ground wire becomes the path for electrical current if the equipment malfunctions.

Without proper grounding, an individual could become the path to ground if he/she touches the equipment. An assured electrical grounding program or ground fault circuit interrupters is required.

5.7.3 Lockout/Tagout

All site workers follow a standard operating procedure for control of hazardous energy sources [Laboratory Administrative Requirement (AR) 8-6, LP 106-01.1). Lockout/tagout procedures are used to control hazardous energy sources, such as electricity, potential energy, thermal energy, chemical corrosivity, chemical toxicity, or hydraulic and pneumatic pressure.

5.7.4 Confined Space

Entry and work to be conducted in confined spaces shall adhere to procedures proposed in the Laboratory Confined Space Entry Program. These procedures require that a Confined Space Entry Permit be obtained and posted at the work site. Prior to entry, the atmosphere shall be tested for oxygen content, flammable vapors, carbon monoxide, and other hazardous gases. Continuous monitoring for these constituents shall be performed if conditions or activities have the potential to adversely affect the atmosphere.

5.7.5 Handling Drums and Containers

Drums and containers used during clean up shall meet U.S. Department of Transportation, OSHA, and EPA regulations. Work practices, labeling requirements, spill containment measures, and precautions for opening drums and containers shall be in accordance with 29 CFR 1910.120. Drums and containers that contain radioactive material must also be labeled in accordance with AR 3-5, Shipment of Radioactive Materials; AR 3-7, Radiation Exposure Control; and Article 412, Radioactive Material Laboratory, DOE Radiological Control Manual. Provisions for these activities shall be clearly outlined in the SSHSP, if applicable.

5.7.6 Illumination

Illumination shall meet the requirements of Table H-120.1, 29 CFR 1910.120. Table III-6 lists OSHA-required illumination levels.

Table III-6. Illumination levels

Foot-candles	Area or operations
5	General site areas
3	Excavation and waste areas, accessways, active storage areas, loading platforms, refueling, and field maintenance areas
5	Indoors: warehouses, corridors, hallways, and exitways
5	Tunnels, shafts, and general underground work areas. (Exception: a minimum of 10 foot-candles is required at tunnel and shaft heading during drilling, mucking, and scaling. Bureau of Mines-approved cap lights shall be acceptable for use in the tunnel heading.)
10	General shops (e.g., mechanical and electrical equipment rooms, active storerooms, barracks or living quarters, locker or dressing rooms, dining areas, and indoor toilets and workrooms)
30	First aid stations, infirmaries, and offices

5.7.7 Sanitation

An adequate supply of potable water shall be provided at the site. Nonpotable water sources shall be clearly marked as not suitable for drinking, washing, or washing purposes. There shall be no cross-connections between potable and nonpotable water systems.

At remote sites, at least one toilet facility shall be provided, unless the crew is mobile and has transportation readily available to nearby toilet facilities.

Adequate washing facilities shall be provided when personnel are potentially exposed to hazardous substances. Washing facilities shall be in areas where exposures to hazardous materials are below permissible exposure limits (PELs) and where employees may decontaminate themselves before entering clean areas.

When showers and change rooms are required, they shall be provided and meet the requirements of 29 CFR 1910.141. In this instance, employees shall be required to shower when leaving the decontamination zone.

5.7.8 Packaging and Transport

The OUPL should contact HS-7 to determine requirements for storing and transporting hazardous waste to ensure that practices for storage, packaging, and transportation comply with ARs 10-2 and 10-3. Disposal of hazardous wastes generated from a project will be handled by HS-7.

5.7.9 Government Vehicle Use

Only government vehicles can be driven onto contaminated sites. No personal vehicles are allowed. All personnel must wear a seat belt when in a moving vehicle, whether it is government or personally owned.

5.7.10 Extended Work Schedules

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

5.8 Permits

5.8.1 Excavation Permits

Any excavation at OU sites must be conducted in accordance with Laboratory AR 1-12, Excavation or Fill Permit Review. Field team leaders will be responsible for determining when excavation permits are required. The OUPL and field team leader are responsible for requesting the excavation permit (Form 70-10-00.1) from the support services contractor. At the top of the form, indicate that this is an ER Program activity. The permit is reviewed by Health and Safety and EM Divisions for environmental safety and health concerns.

5.8.2 Other Permits

The following permits may be required for field activities. The SSO and OUPL are responsible for obtaining permits and maintaining documentation. Permits are specifically addressed in the SSHSP.

- Radiation Work Permits
- Special Work Permit for Spark/Flame-Producing Operations
- Confined Space Entry
- Lockout/Tagout

6.0 PERSONAL PROTECTIVE EQUIPMENT

6.1 General Requirements

PPE shall be selected, provided, and used in accordance with the requirements of this section.

If engineering controls and work practices do not provide adequate protection against hazards, PPE may be required. Use of PPE is required by OSHA regulations in 29 CFR Part 1910 Subpart I (see Table III-7). These regulations are reinforced by EPA regulation 40 CFR Part 300, which requires private contractors working on Superfund sites to conform to applicable OSHA provisions and any other federal or state safety requirements deemed necessary by the lead agency overseeing the activities.

Table III-7. OSHA standards for PPE use

Type of protection	Regulation
General	29 CFR Part 1910.132 29 CFR Part 1910.1000 29 CFR Part 1910.1001-1045
Eye and face	29 CFR Part 1910.133(a)
Hearing	29 CFR Part 1910.95
Respiratory	29 CFR Part 1910.134
Head	29 CFR Part 1910.135
Foot	29 CFR Part 1910.136
Electrical protective devices	29 CFR Part 1910.137

In addition, the use of PPE for radiological protection shall be governed by the Radiation Work Permit (or Safety Work Permits/Radiation Work). AR 3-7 and Article 325, Article 461, Table III-1, and Appendix 3C of the DOE Radiological Control Manual contain guidelines for the use of PC during radiological operations. Efforts should be made to keep disposable PPE used exclusively for radiological work from becoming contaminated with hazardous chemicals, which would generate mixed waste unnecessarily. In sites where both types of contaminants are present, this may not be possible.

6.1.1 PPE Program Elements

PPE programs protect workers from health and safety hazards and prevent injuries as a result of incorrect use and/or malfunction of PPE. Hazard identification, medical monitoring, training, environmental surveillance, selection criteria, use, maintenance, and decontamination of PPE are the essential program elements.

6.1.2 Medical Certification

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

6.2 Levels of PPE

The individual components of clothing and equipment must be assembled into a full protective ensemble that protects the worker from site-specific hazards and minimizes the hazards and disadvantages of the PPE. Attachment A lists ensemble components based on the widely used EPA Levels of Protection: Levels A, B, C, and D. These lists can be used as a starting point for ensemble creation; however, each ensemble must be tailored to the specific situation in order to provide the most appropriate level of protection.

The type of equipment used and the overall level of protection should be re-evaluated periodically as information about the site increases and as workers are required to perform different tasks. Personnel should be able to upgrade or downgrade their level of chemical protection with the concurrence of the SSO. The level of radiological PPE may only be changed as specified in the Radiation Work Permits (or Safety Work Permits/Radiation Work). The following are reasons to upgrade:

- known or suspected presence of dermal hazards,
- occurrence or likely occurrence of gas or vapor emission,
- change in work task that will increase contact or potential contact with hazardous materials, or
- request of the individual performing the task.

The following are reasons to downgrade:

- new information indicating that the situation is less hazardous than was originally thought,
- change in site conditions that decreases the hazard, or
- change in work task that will reduce contact with hazardous materials.

6.3 Selection, Use, and Limitations

Selection of PPE for a particular activity will be based on an evaluation of the hazards anticipated or previously detected at a work site. The equipment selected will provide protection from chemical and/or radiological materials contamination that is known or suspected to be present and that exhibits any potential for worker exposure.

6.3.1 Chemical Protective Clothing

The selection of chemical PC shall be based on an evaluation of the performance characteristics of the clothing relative to the requirements and limitations of the site, the task-specific conditions and duration, and the potential hazards identified at the site.

6.3.2 Radiological Protective Clothing

Radiological PC as prescribed by the Radiological Work Permit should be selected based on the contamination level in the work area, the anticipated work activity, worker health considerations, and regard for nonradiological hazards that may be present. A full set of radiological PC includes coveralls, cotton glove liners, gloves, shoe covers, rubber overshoes, and a hood. A double set of PC includes two pairs of coveralls, cotton glove liners, two pairs of gloves, two pairs of shoe covers, rubber overshoes, and a hood. The following practices apply to radiological PC:

1. Cotton glove liners may be worn inside standard gloves for comfort but should not be worn alone or considered a layer of protection.

2. Shoe covers and gloves should be sufficiently durable for the intended use. Leather or canvas work gloves should be worn in lieu of or in addition to standard gloves for work activities requiring additional strength or abrasion resistance.
3. Use of hard hats in contamination areas should be controlled by the Radiological Work Permit. Hard hats designated for use in such areas should be distinctly colored or marked.

Table III-8 provides general guidelines for selection.

Table III-8. Guidelines for selecting radiological protective clothing

Work activity	Removable contamination levels		
	Low (1 to 10 times Table III-10 values)	Moderate (10 to 100 times Table III-10 values)	High (>100 times Table III-10 values)
Routine	Full set of PC	Full set of PC	Full sets of PC, double gloves, double shoe covers
Heavy work	Full set of PC, work gloves	Double set of PC, work gloves	Double set of PC, work gloves
Work with pressurized or large volume liquids, closed system breach	Full set of non-permeable PC	Double set of PC (outer set nonpermeable), rubber boots	Double set of PC and nonpermeable outer clothing, rubber boots

6.3.3 Protective Equipment

Protective equipment, including protective eyewear and shoes, head gear, hearing protection, splash protection, lifelines, and safety harnesses, must meet American National Standards Institute standards.

6.4 Respiratory Protection Program

When engineering controls cannot maintain airborne contaminants at acceptable levels, appropriate respiratory protective measures shall be instituted. The Health and Safety Division administers the respiratory protection program, which defines respiratory protection requirements; verifies that personnel have met the criteria for training, medical surveillance, and fit testing; and maintains the appropriate records.

All supplemental workers shall submit documentation of participation in an acceptable respiratory protection program to the Industrial Hygiene Group (HS-5) for review and signature approval before using respirators on-site.

7.0 HAZARD CONTROLS

7.1 Engineering Controls

OSHA regulations state that when possible engineering controls should be used as the first line of defense for protecting workers from hazards. Engineering controls are mechanical means for reducing hazards to workers, such as guarding moving parts on machinery and tools or using ventilation during confined space entry.

7.1.1 Engineering Controls for Airborne Dust

Airborne dust can be a hazard when it is a nuisance or when radionuclides and/or hazardous substances attach to soil particles.

During drilling or any other activity where localized dust is being generated, a sprayer containing water or water amended with surfactants may be used to wet the soil and suppress the dust. Spraying must be repeated often to maintain moist soil.

A windscreen may be effective in reducing dust from relatively small earth-moving operations. In extreme cases, a temporary enclosure can be constructed to control dust. This method is the more expensive and may increase the level of PPE required for workers (in the enclosure).

Where there are high winds in an area of little or no vegetation or a large, dusty area, small quantities of water are not effective. In these instances, a water truck may be used to wet the area to suppress the dust. This may require frequent spraying to be effective. Other materials may also be considered for dust suppression. The amount of water applied needs to be carefully controlled so that enough is used to be effective without spreading contamination by runoff or as mud tracked off-site on vehicle tires. Positive air pressure cabs are an effective method for controlling equipment operator dust exposure.

7.1.2 Engineering Controls for Airborne Volatiles

Drilling, trenching, and soil and tank sampling activities may produce gases, fumes, or mists that may be inhaled or ingested by workers without protection. Engineering controls may be implemented to reduce exposure to these hazards. Natural ventilation (wind) can be an effective control measure; workers should be located upwind of the activity whenever possible.

Mechanical ventilation is desirable in closed or confined spaces. The fan or blower may be attached to a large hose to push or pull the contaminant from the confined space. Pulling the air from the space is more effective at removing the vapors, whereas forcing air into the confined area ensures acceptable oxygen levels from ambient air.

7.1.3 Engineering Controls for Noise

Drilling and trenching are likely to produce high noise levels. On most rigs, the highest noise levels are encountered on the side of the rig because the front and rear of the rig's engine is covered, whereas the sides are left open to cool the engine. Additional barriers may be constructed to reduce high noise levels on the sides of the rig. Insulated cabs usually reduce noise to an acceptable level for equipment operators.

7.1.4 Engineering Controls for Trenching

Entry into an excavation deeper than 5 feet should be avoided if possible. However, it is sometimes necessary to enter trenches to obtain needed information. OSHA regulations for trenches and excavations require engineering controls to prevent cave-ins. These controls include the use of shoring, sloping, and benching.

Benching is a series of steps dug around the excavation at a specified angle of repose determined by the soil type. Benching will normally be found in large excavations. Sloping is a similar system of stabilizing soil but is performed without the steps. Again, the angle of repose is determined by the soil type. This method is generally used for medium-sized excavations, such as tank removal. Shoring is available in many different varieties, but the principle theory is the same. The sides of the excavation are supported by some type of wall that is braced to prevent cave-ins. This method is used most often in deep, narrow trenches for installing water pipe or drainage systems and exploratory trenching. Engineering controls for excavations should be approved by a competent person before entering the excavation.

7.1.5 Engineering Controls for Drilling

Working with and around drilling rigs presents workers with a number of hazards from moving parts and hazardous energy associated with the equipment. Engineering controls include guards to prevent crushing injuries and a maintenance program to ensure replacement of worn or broken parts. Inspections should be performed at the beginning of the job and periodically during the project.

7.2 Administrative Controls

Administrative controls are necessary when hazards are present and engineering controls are not feasible. Administrative controls are a method for controlling the degree of exposure (e.g., how long or how close to the hazard the worker remains). Worker rotation shall not be used to achieve compliance with PELs or dose limits.

7.2.1 Administrative Controls for Airborne Chemical and Radiological Hazards

Personnel should only enter the exclusion zone when required. Chemical and radiological hazards are to be monitored during performance of duties in the exclusion zone. If the concentration of radionuclides or toxic materials exceeds acceptable limits, personnel should be removed from the area until natural or mechanical ventilation reduces concentrations to an acceptable level.

7.2.2 Administrative Controls for Noise

Another approach to noise exposure control, besides engineering measures, is the use of administrative controls. This is often thought of as the rotation of workers between noisy jobs and less noisy jobs. This is not a good health practice because, while it may reduce the amount of hearing loss individuals incur, it spreads the risk among other workers. The final result tends to be that many workers develop small hearing losses rather than a few workers developing greater loss. One control than can partially mitigate the problem is to provide workers with rest and lunch areas that are quiet enough to allow some recovery from temporary threshold shifts. The levels in these areas should not exceed 70 decibels. Workers should also be located as far from loud noise sources as practicable. This allows for noise attenuation before it reaches the individual. Finally, duration of exposure should be limited to the minimum time. Under no circumstances should workers be exposed to noise levels in excess of the time limits specified in 29 CFR 1910.95, Occupational Noise Exposure, Table G-16.

7.2.3 Administrative Controls for Trenching

Trenches less than 5 foot deep do not require protective systems (sloping, benching, or shoring). All trenches should be excavated to a depth of less than 5 feet if possible. However, monitoring inside the trench and means of egress (every 25 feet) must be implemented when the trench reaches a depth of 4 feet. Soil piles, tools, and other debris must be stored at least 2 feet from the edge of the excavation. Inspections should be made by a competent person before any field team member is allowed to enter the excavation. When the area is not occupied, all excavations must be marked to restrict access.

7.2.4 Administrative Controls for Working Near the Mesa Edge

Slip, trip, and fall hazards exist around the mesa edge. These hazards may be avoided by good housekeeping in the work area near the edge of the mesa. Additionally, personnel shall remain 5 feet from the edge. If necessary, ropes or guards will be used to delineate this restricted area. Exceptions to this requirement are for canyon-side sampling and outfall sampling. In those instances, the worker taking the sample must be tied to a lifeline before descending over the edge. When working with a lifeline, an attendant must always be present.

8.0 SITE MONITORING

This section describes the requirements for chemical, physical, and radiological agent monitoring. This does not include biological monitoring, which is covered in Sections 9 and 10. This information will be used to delineate work zone boundaries, identify appropriate engineering controls, select the appropriate level of PPE, ensure the effectiveness of decontamination procedures, and protect public health and safety.

A monitoring program or plan that meets the requirements of 29 CFR 1910.120 will be implemented for each OU. Laboratory-approved sampling, analytical, and recordkeeping methods must be used. A detailed monitoring strategy will be incorporated into each SSHSP. The strategy will describe the frequency, duration, and type of samples to be collected.

If exposures exceed acceptable limits, the ER Program Manager and HSPL will be notified. An investigation of the source, exposures to personnel working in the OU and in adjoining areas, any bioassay or other medical evaluations needed, and an assessment of environmental impacts shall be initiated as soon as possible under the guidance of the Health and Safety Division.

Contractors will be responsible for providing their own monitoring equipment and for determining their employees' occupational exposures to hazardous chemical and physical agents during activities performed at the OU. The Laboratory will perform oversight duties during these activities.

8.1 Chemical Air Contaminants

DOE has adopted OSHA PELs and ACGIH TLVs as standards for defining acceptable levels of exposure. The more stringent of the two limits applies.

8.1.1 Measurement

Measurements of chemical contaminants can be performed using direct or indirect sampling methods. Direct methods provide near real-time results and are often used as screening tools to determine levels of PPE, the need for additional sampling, etc. Examples of direct-reading instruments include the HNu photoionization detector, the organic vapor analyzer with flame ionization detector, and a gas detector pump with colorimetric tubes. Generally, these instruments are portable, easy to operate, and durable. They are less specific and sensitive than many indirect methods.

Indirect sampling means that a sample is collected in the field and transported to a laboratory for analysis. This usually involves setting up a sampling train consisting of a portable sampling pump, tubing, and sampling media (cassette, sorbent tube, impinger, etc.). The advantage of the indirect method is greater specificity and sensitivity than many direct-reading instruments. The disadvantage is the longer turnaround time for results and the inconvenience.

Air sampling for chemical contaminants at this OU will use both direct and indirect methods. It will be up to the SSO to determine the most appropriate sampling method for each situation. If there are any questions about sampling methodology, the SSO should consult with the HSPL or a certified industrial hygienist.

8.1.2 Personal Monitoring

The site history should be used to determine the need for monitoring for specific chemical agents. Instruments that monitor for a wide range of chemicals, such as the organic vapor analyzer, combustible gas indicator, and HNu, may be used for screening purposes.

Initial air monitoring shall be performed to characterize the exposure levels at the site and to determine the appropriate level of personal protection needed. In addition, periodic monitoring is required when:

- work is initiated in a different part of the site,
- unanticipated contaminants are identified,
- a different type of operation is initiated (i.e., soil boring versus drum opening), or
- spills or leakage of containers is discovered.

Instrument readings should be taken in or near the worker's breathing zone. Individuals working closest to the source have the greatest potential for exposure to concentrations above acceptable limits. Monitoring strategies will emphasize worst-case conditions if monitoring each individual is inappropriate.

8.1.3 Perimeter Monitoring

Perimeter monitoring shall be performed to characterize airborne concentrations in adjoining areas. If results indicate that contaminants are moving off-site, control measures must be re-evaluated. The perimeter is defined as the boundary of the OU site.

8.2 Physical Hazards

Physical hazards of concern that can be readily measured include noise, vibration, and temperature. These variables must be monitored to prevent injuries and illnesses related to overexposure.

8.2.1 Measurement

Most of the instruments used to measure these agents are direct reading. Many have the ability to take short-term measurements and/or integrated, longer term measurements. Typically, short-term measurements are made during an initial survey. The results can then be used to determine whether longer term (i.e., full shift) monitoring is warranted.

8.2.2 Personal Monitoring

Noise dosimeters are used to estimate the actual exposure or dose that a worker receives during the shift. Results of personal noise monitoring should be compared to the ACGIH TLVs in accordance with Laboratory policy. These results dictate whether workers must be included in a hearing conservation program.

Instrumentation is now available for personal monitoring for heat stress. This type of measurement is not mandated but can provide useful exposure information. Use of personal heat stress monitors must be approved by the HSPL prior to field use.

Personal monitoring for vibration and cold stress is generally not performed or warranted for this type of operation.

8.2.3 Area Monitoring

A sound level survey meter should be used to initially characterize sound pressure levels. These data can help guide the personal monitoring efforts. If the sound level survey and personal dosimetry indicate that sound levels exceed acceptable levels, then an octave band analyzer may be used to characterize the noise. This provides important data for designing engineering controls.

Area monitoring for temperature extremes are usually sufficient for determining whether workers are potentially exposed to harmful conditions. Thermometers, psychrometers, and anemometers are direct-reading instruments that provide the data necessary to make heat and cold stress calculations.

Accelerometers can be used to monitor vibration levels. Vibration is usually an isolated problem and does not warrant an ongoing monitoring program. Rather, the SSO should be alert for equipment and tasks that might expose workers to significant whole-body or hand and arm vibration. Typically, these include operation of dozers, scrapers, and other heavy equipment and power hand tools, such as impact wrenches and concrete breakers.

8.3 Radiological Hazards

When radiological hazards are known or suspected, workplace monitoring shall be performed as necessary to ensure that exposures are within the requirements of DOE Order 4380.11 and are as low as reasonably achievable (ALARA). Workplace monitoring consists of monitoring for airborne radioactivity, external radiation fields, and surface contamination. The Laboratory's workplace monitoring program is described in AR 3-7, Radiation Exposure Control. The success of the monitoring program in controlling exposures is measured by the personnel dosimetry and bioassay programs. Chapter 3, Part 7, of the DOE Radiological Control Manual provides additional guidelines for radiological control during construction and restoration projects. All monitoring instruments shall meet the Laboratory's requirements for sensitivity, calibration, and quality assurance. In addition, all monitoring shall be carried out in accordance with approved procedures.

8.3.1 Airborne Radioactivity Monitoring

Air monitoring shall be performed in occupied areas with the potential for airborne radioactivity. Air monitoring may include the use of portable high and low volume samplers, continuous air monitors, and personnel breathing zone samplers. In areas where concentrations are likely to exceed 10% of any derived air concentration listed in DOE Order 5480.11, real-time continuous air monitoring shall be provided. Action levels based on air monitoring results shall be established to increase dust suppression activities, upgrade PPE, and stop work.

8.3.2 Area Monitoring for External Radiation Fields

Area monitoring for external radiation fields shall be performed with portable survey instruments capable of measuring a wide range of beta/gamma dose rates. In areas where dose rates above a preset action level are expected, the monitoring should be continuous. Additional action levels shall be established based on external radiation monitoring results.

8.3.3 Monitoring for Surface Contamination

Area monitoring for surface contamination during operations shall be conducted whenever a new surface is uncovered in a suspected radioactively contaminated area (i.e., the levels may exceed the surface contamination limits in DOE Order 4380.11). Personnel and equipment shall be monitored whenever there is reason to suspect contamination and upon exit from a suspected radioactively contaminated area. Action levels for decontamination shall be established.

8.3.4 Personnel Monitoring for External Exposure

Personnel dosimetry shall be provided to OU workers who have the potential in a year to exceed any one of the following from external sources in accordance with DOE Order 5480.11:

- 100 mrem (0.001 sievert) annual effective dose equivalent to the whole body,
- 5 rem (0.05 sievert) annual dose equivalent to the skin,
- 5 rem (0.05 sievert) annual dose equivalent to any extremity, or
- 1.5 rem (0.015 sievert) annual dose equivalent to the lens of the eye.

Normally, workers meeting the above criteria will be monitored with thermoluminescent dosimeters (TLDs). TLDs shall either be provided by the Laboratory or shall meet DOE requirements if provided by the subcontractor. Section 10 (Bioassay Program) discusses personnel monitoring for internal exposure.

8.3.5 ALARA Program

ALARA considerations in the workplace are best served by near real-time knowledge of personnel exposures and frequent workplace monitoring to establish adequate administrative control of exposure conditions. Consequently, for the OU site projects, ALARA efforts consist of two integrated approaches, which are described in the following sections.

8.3.5.1 Workplace ALARA Efforts

Judicious application of basic time, distance, physical controls, and PPE principles will be used to limit exposures to ALARA levels. To verify that established control is adequate, workplace monitoring for radioactive materials and field instrument detectable chemicals will be conducted in direct proportion to expected and/or observed levels of exposure. Activities that result in unexpectedly high potential exposures will be terminated until provisions are made that permit work to proceed in acceptable ALARA fashion.

8.3.5.2 Programmatic ALARA Efforts

External and internal exposures of record are comprised of TLD badges and bioassay data, respectively. Field dose calculation, direct-reading pocket meters, and event-based lapel air sampling data are used to maintain estimates of personnel exposures to both radioactive materials and hazardous chemicals. These estimates are correlated with job-specific activities (work location and work category) and individual-specific activities (job function).

Periodic reviews of personnel exposure estimates are conducted to identify unfavorable trends and unexpectedly high potential exposures. Activities (as functions of work location, work categories, and job functions) that indicate unfavorable trends will be investigated, and recommendations will be made for additional administrative and/or physical controls, as appropriate.

All unfavorable trends and unexpectedly high potential exposures must be reported to the HSPL, who will make recommendations for corrective action.

9.0 MEDICAL SURVEILLANCE AND MONITORING

9.1 General Requirements

A medical surveillance program shall be instituted to assess and monitor the health and fitness of workers engaged in HAZWOP. Medical surveillance is required for personnel who are or may be exposed to hazardous substances at or above established PELs for 30 days in a 12-month period, as detailed in 29 CFR 1910.120. Medical surveillance is also required for personnel with duties that require the use of respirators or with symptoms indicating possible overexposure to hazardous substances.

Contractors are responsible for medical surveillance of their employees. The Health and Safety Division will audit contractor programs.

9.2 Medical Surveillance Program

All field team members who participate in ER Program investigations shall participate in a medical surveillance program. The program shall conform to DOE Order 5480.10, 29 CFR 1910.120, AR 2-1, and any criteria established by the Occupational Medicine Group (HS-2) at the Laboratory. The program shall provide for initial medical evaluations to determine fitness for duty and subsequent medical surveillance of individuals engaged in HAZWOP. As a minimum, the program shall include:

- **Surveillance.** An occupational and medical history, a baseline exam prior to employment, periodic medical exams, and termination exams shall be included. The frequency of medical exams may vary because of the exposure potential at hazardous waste sites. The frequency of exams will be determined by the physician.
- **Treatment.** Immediate consultation shall be made available to any employee who develops signs or symptoms of exposure or who has been exposed at or above PELs in an uncontrolled or emergency situation.
- **Recordkeeping.** An accurate record of the medical surveillance required by 20 CFR 1910.120 shall be retained. This record shall

be retained for the period specified and meet the criteria of 29 CFR 1910.20.

- **Program review.** Contractors must provide adequate documentation that their medical program complies with all applicable standards, DOE orders, and Laboratory requirements. This documentation must be submitted for review and approval before work begins.
- **Program participation.** Line management is responsible for identifying employees for inclusion in the surveillance program.

9.2.1 Medical Surveillance Exams

AR 2-1 from the Laboratory's ES&H Manual specifies that medical surveillance examinations are required for employees who work with asbestos, beryllium, carcinogens, hazardous waste, high noise, lasers, and certain other materials. As specified above, Laboratory employees who work with hazardous waste must undergo periodic special examinations by HS-2.

The content and frequency of medical exams is dependent on site conditions, current and expected exposures, job tasks, and the medical history of the workers.

9.2.2 Certification Exams

In addition to the above medical surveillance requirements, medical certification is required for employees whose work assignments include respirator use, Level A chemical PC, and/or operation of cranes and heavy equipment. To become certified and maintain certification, medical evaluations as specified by HS-2 are required.

9.3 Fitness for Duty

A fitness for duty determination will be made for each site worker. The examining physician shall provide a report to the OUPL indicating:

- approval to work on hazardous waste sites,
- approval to wear respiratory protective equipment, and
- a statement of work restrictions.

9.4 Emergency Treatment

In the event of an on-the-job injury, HS-2 will implement required reporting and recordkeeping procedures. The SSHSP describes the actions to be taken by the employee at the time of the injury/illness.

10.0 BIOASSAY PROGRAM

The OU site field characterization efforts will include intrusive investigations of areas of unknown but highly probable contamination potential. Given the uncertainties associated with this type of field work, the project internal exposure monitoring program is based on the assumption that personnel will be exposed to significant quantities of radioactive and/or hazardous chemical contaminants. Accordingly, the project internal dosimetry program will be conducted in accordance with the provisions of HS-12. These provisions are outlined in the following sections. (Monitoring and control of internal contamination by hazardous chemical contaminants is included in the medical surveillance program.)

10.1 Baseline Bioassays

Individuals who are assigned to field activities or who have reason to visit or inspect field activities are assigned one of the following job categories:

I. Work involving full-time on-site activities.

II. Work involving support activities (e.g., supervision or inspection).

III. Work involving routine or frequent visits (e.g., observing, auditing, etc.).

IV. Work involving nonroutine or infrequent visits (e.g., management observations).

All such individuals (except category IV individuals) must submit urine samples and submit to whole-body counting prior to participation in field activities. The baseline urine samples are analyzed for the solubility Class D and Class W compounds that could reasonably be expected to be encountered at the Laboratory. Whole-body counting analyzes for the gamma-emitting radionuclides that could reasonably be expected to be encountered at the Laboratory.

Results of the baseline bioassay analyses are evaluated by a health physics specialist for evidence of previous exposure. Individuals exhibiting evidence of previous internal contamination will not be permitted to enter OU sites until an evaluation of the previous exposure indicates that additional, planned radiation exposure will not result in doses in excess of applicable regulatory limits. This evaluation may include additional, rigorous sampling and/or counting to establish the physical and temporal parameters necessary to adequately assess the committed effective dose equivalent.

10.2 Routine Bioassays

The *routine* bioassay program is used as a measure of the effectiveness of the respiratory protection program. As such, the bioassay frequency will be a function of potential exposure to airborne radioactive materials and will be determined by a health physics specialist.

Evidence of inadequate respiratory protection will be cause for an investigation of the responsible field operation(s). The HSPL is responsible for investigating and identifying probable causes of the respiratory protection program failure and for recommending corrective actions.

11.0 DECONTAMINATION

11.1 Introduction

Decontamination is the process of removing or neutralizing contaminants that have accumulated on personnel and equipment and is critical to health and safety at hazardous waste sites. Decontamination protects workers from hazardous substances that may contaminate PC, respiratory protection equipment, tools, vehicles, and other equipment used on-site. It minimizes the transfer of harmful materials into clean areas, helps prevent mixing of incompatible chemicals, and prevents uncontrolled transportation of contaminants from the site into the community.

All personnel and equipment exiting an exclusion zone will be monitored to detect possible contamination. Monitoring will verify that all personnel and equipment are free of significant contamination prior to exiting the exclusion zone and shall be performed in accordance with Health and Safety Division requirements.

If monitoring indicates that an employee is contaminated with chemicals, biological agents, or radioactive materials, the employee's immediate supervisor shall notify the SSO, who records the details of the incident, determines whether any personal injury is involved, initiates decontamination, and, when necessary, notifies the OUPL and HSPL. All contamination incidents shall be immediately reported following Laboratory Occurrence Reporting Program requirements to ensure that prompt notifications and appropriate emergency response actions are enacted.

11.1.1 Decontamination Plan

A site decontamination plan is mandatory. The site decontamination plan shall be part of the SSHSP and must include:

- the number and layout of decontamination stations,
- the decontamination equipment needed,
- appropriate decontamination methods,
- procedures to prevent contamination of clean areas,
- methods and procedures to minimize worker contact with contaminants during removal of personal PC, and

- methods for disposing of clothing and equipment that are not completely decontaminated.

The plan should be revised whenever the type of personal PC or equipment changes, the site conditions change, or the site hazards are re-assessed based on new information.

11.1.2 Facilities

Clean areas shall be separate from contaminated areas and materials. The SSO will verify that decontamination facilities are maintained in acceptable condition and that supplies of decontaminating agents and other materials are available. Personnel decontamination facilities shall be equipped with showers, clean work clothing, decontamination agents, and, when necessary, a decontamination area where Health and Safety Division personnel can assist in decontaminating individuals. All wash solutions shall be retained for appropriate disposal.

11.1.3 General Decontamination Methods

Many factors such as cost, availability, and ease of implementation influence the selection of a decontamination method. From a health and safety standpoint, two key questions must be addressed:

- Is the decontamination method effective for the specific substances present?
- Does the method itself pose any health or safety hazards?

The details of decontamination techniques shall be included in the site decontamination plan. The following are some decontamination methods.

Removal

- Contaminant removal
    - Water rinse using pressurized spray or gravity flow shower
    - Chemical leaching and extraction
    - Evaporation/vaporization
    - Pressurized air jets
    - Scrubbing/scraping (using brushes, scrapers, or sponges and water-compatible solvent cleaning solutions)
    - Steam jets
- Removal of contaminated surfaces
    - Disposal of deeply permeated materials (e.g., clothing, floor mats, and seats)
    - Disposal of protective coverings/coatings

Inactivation

- Chemical detoxification
    - Halogen stripping
    - Neutralization
    - Oxidation/reduction
    - Thermal degradation
- Disinfection/sterilization
    - Chemical disinfection
    - Dry heat sterilization
    - Gas/vapor sterilization
    - Irradiation
    - Steam sterilization

11.1.3.1 Physical Removal

In many cases, gross contamination can be removed by dislodging/displacement, rinsing, wiping off, and evaporation. Physical methods involving high pressure and/or heat should be used only as necessary and with caution because they can spread contamination and cause burns. Contaminants that can be removed by physical means can be categorized as follows:

- **Loose contaminants.** Dusts and vapors that cling to equipment and workers or become trapped in small openings, such as the weave of fabrics, can be removed with water or a liquid rinse. Removal of electrostatically attached materials can be enhanced by coating the clothing or equipment with antistatic solutions. These are available commercially as wash additives or antistatic sprays.

- **Adhering contaminants.** Some contaminants adhere by forces other than electrostatic attraction. Adhesive qualities vary greatly with the specific contaminants and temperature. For example, contaminants such as glues, cements, resins, and muds have much greater adhesive properties than elemental mercury, and consequently, are difficult to remove by physical means. Physical removal methods for gross contaminants include scraping, brushing, and wiping. Removal of adhesive contaminants can be enhanced through certain methods such as solidifying, freezing (e.g., using dry ice or ice water), adsorption or absorption (e.g., with powdered lime or cat litter), or melting.
- **Volatile liquids.** Volatile liquid contaminants can be removed from PC or equipment by evaporation followed by a water rinse. Evaporation of volatile liquids can be enhanced by using steam jets. With any evaporation or vaporization process, care must be taken to prevent worker inhalation of the vaporized chemicals.

11.1.3.2 Chemical Removal

Physical removal of gross contamination should be followed by a wash/rinse process using cleaning solutions. These cleaning solutions normally use one or more of the following methods:

- **Dissolving contaminants.** Chemical removal of surface contaminants can be accomplished by dissolving them in a solvent. The solvent must be chemically compatible with the equipment being cleaned. This is particularly important when decontaminating personal PC. In addition, care must be taken in selecting, using, and disposing of any organic solvents that may be flammable or potentially toxic. Organic solvents include alcohols, ethers, ketones, aromatics, straight-chain alkanes, and common petroleum products.

Halogenated solvents are generally incompatible with PPE and are toxic. They should only be used for decontamination in extreme cases, when other cleaning agents will not remove the contaminant. Use of halogenated solvents must be approved by the HSPL.

Table III-9 provides a general guide to the solubility of several contaminants in four types of solvents: water, dilute acids, dilute bases, and organic solvents. Because of the potential hazards, decontamination using chemicals should only be performed if recommended by an industrial hygienist or other qualified health professional.

- **Surfactants.** Surfactants augment physical cleaning methods by reducing adhesion forces between contaminants and the surface being cleaned and by preventing redeposit of the contaminants. Household detergents are among the most common surfactants. Some detergents can be used with organic solvents to improve the dissolving and dispersal of contaminants into the solvent.
- **Solidification.** Solidifying liquid or gel contaminants can enhance their physical removal. The mechanisms of solidification are: (1) moisture removal through the use of adsorbents such as ground clay or powdered lime, (2) chemical reactions via polymerization catalysts and chemical reagents, and (3) freezing using ice water.
- **Rinsing.** Rinsing removes contaminants through dilution, physical attraction, and solubilization. Multiple rinses with clean solutions remove more contaminants than a single rinse with the same volume of solution. Continuous rinsing with large volumes will remove even more contaminants than multiple rinsings with a lesser total volume.
- **Disinfection/Sterilization.** Chemical disinfectants are a practical means of inactivating infectious agents. Unfortunately, standard sterilization techniques are generally impractical for large equipment and for personal PC and equipment. For this reason, disposable PPE is recommended for use with infectious agents.

Table III-9. General guide to contaminant solubility

Solvent	Soluble contaminants
Water	Low-chain hydrocarbons, inorganic compounds, salts, some organic acids and other polar compounds
Dilute acids	Basic (caustic) compounds, amines, hydrazines
Dilute bases — detergent — soap	Acidic compounds, phenols, thiols, some nitro and sulfonic compounds
Organic solvents* — alcohols — ethers — ketones — aromatics — straight-chain alkanes (e.g., hexane) — common petroleum products (e.g., fuel oil, kerosene)	Nonpolar compounds (e.g., some organic compounds)

*WARNING: Some organic solvents can permeate and/or degrade the PC.

11.1.4 Emergency Decontamination

In the event of personnel contamination with highly caustic, strongly acidic, and/or high levels of radioactive materials (100 mrad/hour), emergency shower facilities shall be used as a first level decontamination. These facilities shall be adequate to treat a minimum of two contaminated individuals at one time. Appropriate medical and radiation safety personnel will be relied upon to assist as needed. Use of these facilities shall be in accordance with Health and Safety Division requirements.

11.2 Personnel

The SSO is responsible for enforcing the decontamination plan. All personnel leaving the exclusion zone must be decontaminated to remove any chemical or infectious agents that may have adhered to them.

11.2.1 Radiological Decontamination

Personnel exiting contamination areas, high contamination areas, airborne radioactivity areas, or radiological buffer areas established for contamination control shall be frisked for contamination. This does not apply to personnel exiting areas containing only radionuclides, such as tritium, that cannot be detected using hand-held or automatic frisking equipment.

Monitoring for contamination should be performed using frisking equipment that, under laboratory conditions, can detect total contamination of at least the values specified in Table III-10. Use of automatic monitoring units that meet the above requirements is encouraged.

Personnel with detectable contamination on their skin or personal clothing, other than noble gases or natural background radioactivity, should be promptly decontaminated.

11.2.2 Chemical Decontamination

The decontamination of chemically contaminated personnel will be detailed in the site decontamination plan. Section 11.1.3.2 provides guidance on chemical decontamination.

11.3 Equipment Decontamination

11.3.1 Responsibilities and Authorities

The SSO is responsible for ensuring that tools and equipment are surveyed for contamination before they are removed from the site. The SSO is also responsible for ensuring that tools and equipment are decontaminated to acceptable levels prior to release for unrestricted use.

Table III-10. Summary of contamination values

Nuclide[a]	Removable (dpm/100 cm^2)[b,c]	Total (fixed + removable) (dpm/100 cm^2)
Natural uranium, uranium-235, uranium-238, and associated decay products	1,000 alpha	5,000 alpha
Transuranics, radium-226, radium-228, thorium-230, thorium-228, protactinium-231, actinium-227, iodine-125, and iodine-129	20	500
Natural thorium, thorium-232, strontium-90, radium-223, radium-224, uranium-232, iodine-126, iodine-131, and iodine-133	200	1,000
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except strontium-90 and others noted above. Includes mixed fission products containing strontium-90	1,000 beta-gamma	5,000 beta-gamma
Tritium organic compounds, surfaces contaminated by HT, HTO, and metal tritide aerosols	10,000	10,000

[a] The values in this table apply to radioactive contamination deposited on but not incorporated into the interior of the contaminated item. Where contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for the alpha- and beta-gamma-emitting nuclides apply independently.

[b] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by swiping the area with dry filter or soft absorbent paper while applying moderate pressure and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency. For objects with a surface area less than 100 cm^2, the entire surface should be swiped, and the activity per unit area should be based on the actual surface area. Except for transuranics, radium-228, actinum-227, thorium-228, thorium-230, protactinium-231, and alpha emitters, it is not necessary to use swiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual contamination levels are below the values for removable contamination.

[c] The levels may be averaged over 1 m^2 if the maximum activity in any area of 100 cm^2 is less than three times the guide values.

11.3.2 Facilities

Prior to release from the site, tools and equipment contaminated with removable radioactive and chemical materials in excess of applicable limits will be manually decontaminated at the field location.

Tools and equipment that cannot be field decontaminated to below applicable limits may be appropriately packaged and removed to a decontamination facility. Transportation of contaminated tools or equipment off-site must be approved by the HSPL.

11.3.3 Radiological

Decontamination of equipment must follow approved procedures. A surface shall be considered contaminated if either the removable or total radioactivity is detected above the levels in Table III-10. If an item cannot be decontaminated promptly, then it shall be posted as specified in AR 3-7. Radiological Work Permits or technical work documents shall include provisions to control contamination at the source to minimize the amount of decontamination needed. Work preplanning shall include consideration of the handling, temporary storage, and decontamination of materials, tools, and equipment.

Decontamination activities shall be controlled to prevent the spread of contamination. Water and steam are the preferred decontamination agents. Other cleaning agents should be selected based on their effectiveness, hazardous properties, amount of waste generated, and ease of disposal. Decontamination methods should be used to reduce the number of contaminated areas. Efforts should be made to reduce the level of contamination and the number and size of contaminated areas that cannot be eliminated. Line management is responsible for directing decontamination efforts.

11.3.4 Chemical

Chemical decontamination is performed in accordance with product labels. Random sampling and analysis of final rinse solutions may be performed to check the effectiveness of the decontamination procedures.

11.4 Waste Management

Fluids and materials resulting from decontamination processes will be contained, sampled, and analyzed for contaminants. Those materials determined to be contaminated in excess of appropriate limits are packaged in approved containers and disposed of in accordance with EM Division procedures.

12.0 EMERGENCIES

12.1 Introduction

Emergency response, as defined by 29 CFR 1910.120, will be handled by Laboratory personnel. ER contractors are responsible for developing and implementing their own emergency action plans as defined in 29 CFR 1910.38. All emergency action plans must be consistent with laboratory emergency response plans. The SSO, with assistance from the field team leader, will have the responsibility and authority for coordinating all emergency response activities until the proper authorities arrive and assume control.

12.2 Emergency Response Plan

The Laboratory Emergency Management Office oversees and implements the full range of activities necessary for mitigating, preparing for, responding to, and recovering from emergency incidents at the Laboratory. Additional references for this section include Laboratory AR 1-1, Accident/Incident Reporting; AR 1-2, Emergency Preparedness; AR 1-8, Working Alone; and Technical Bulletin 101, Emergency Preparedness.

The Laboratory Emergency Response Plan establishes an organization capable of responding to the range of emergencies at the Laboratory. Provisions are made for rapid mobilization of the response organizations and for expanding response commensurate with the extent of the emergency.

An Emergency Manager with the authority and responsibility to initiate emergency action under the provisions of the Laboratory Emergency Response Plan is available at all times.

When an emergency occurs at the Laboratory, the Laboratory emergency response organization is responsible for all elements of response throughout the duration of the emergency. The Incident Commander is responsible for initial notification and communications and for providing protective action recommendations to buildings/areas within the emergency response zone and off-site.

The Laboratory Emergency Response Plan is designed to be compatible with emergency plans developed by local, state, tribal, and federal agencies through establishment of communications channels with these agencies and by setting criteria for the notification of each agency. This section considers contingency plans for specific types of emergencies. The site safety officer, with assistance from the field teams manager and, if needed, the field team leader, shall have responsibility and authority for coordinating all emergency-response activities until the proper authorities arrive and assume control. A copy of pre-existing OU 1093 emergency response plans shall be available at the work site at all times, and all personnel working at the site shall be familiar with the plans.

For general emergencies that require evacuation (i.e., fire, medical, security, releases, etc.) an emergency response plan specific to OU 1093 is required (OSHA 1986). This section will establish evacuation routes for personnel to follow in the event of an emergency. In a worst case, an evacuation of all personnel from the OU 1093 work area would be required; in most instances a safe distance may be established to protect personnel.

12.2.1 Fire/Explosion

In the event of a fire, the work area will be evacuated and the LANL Fire Department will be notified. In the event of an explosion, all personnel will be evacuated, and no one will enter the work area until it has been cleared by Laboratory explosives safety personnel.

If a major fire or explosion were to occur, site personnel with fire extinguishers would be of no use. The signal for a fire is a siren ("woop, woop"). The signal for an evacuation is a cam alarm with a wavering tone. The crew is to gather at a specified safe location. One person should find the nearest phone at a safety distance and call the fire department at 9-911. The phone and the evacuation route used by field personnel should be in the direction away from the fire and toward the nearest exit. The site safety officer will determine the next course of action.

A major release or fire involving hazardous or radioactive materials may warrant a different approach. When the emergency signal is heard, personnel will meet at a predetermined area, which will be determined based on the wind conditions. A portable wind sock or streamer will be positioned at each work location and personnel notified of the location. All personnel will move in an upwind direction as much as possible without entering a plume. If the source of the fire or release is directly upwind, personnel will move to the exit or gate side and away from the plume (if visible). Once a safe distance is reached, all personnel are to be accounted for. The field team manager and the site safety officer will be responsible for this task. At that time, the site safety officer will determine the next course of action.

For a less severe accident, such as a minor release or small fire, a full evacuation may not be necessary. All personnel will meet at a designated area and all personnel will be accounted for. The field team manager and the site safety officer will be responsible for this task, and will be given instructions by the site safety officer. Emergency procedures will be reviewed at least once per week as a reminder to field personnel.

If a combustible gas meter indicates gas concentrations at levels of 20% of the lower explosive limit, personnel will be evacuated. The site safety officer will continue monitoring to determine when equipment should be removed or when personnel may re-enter the area and resume work.

12.2.2 Personnel Injuries

In case of serious injuries, the victim should be transported to a medical facility as soon as possible. The LANL Fire Department provides emergency transport services. Minor injuries may be treated by trained personnel in the work area. All injuries should be reported to HS-2 Occupational Medicine Group. In the event that an injured person has been contaminated with chemicals, decontamination will be performed to prevent further exposure only if it will not aggravate the injury (as outlined in Section 4.6.2). Treatment of life-threatening or serious injuries will always be undertaken first. If exposure occurs to hydrofluoric acid, special treatment is required. The hospital must be notified immediately and a special paste will be obtained and applied to the affected area. This paste is currently located at HS-2.

12.3 Emergency Action Plan

An emergency action plan provides emergency information for contingencies that may arise during the course of field operations. It provides site personnel with instructions for the appropriate sequence of responses in the event of either site emergencies or off-site emergencies. The emergency action plan will be attached to the SSHSP. The following elements, at a minimum, shall be included in the written plan:

- pre-emergency planning,
- emergency escape procedures and routes/site map,
- procedures to be followed by personnel who remain to operate critical equipment before they evacuate,
- procedures to account for all employees after evacuation,
- rescue and medical duties for those who are to perform them,
- names of those who can be contacted for additional information on the OUHSP,
- emergency communications,
- types of evacuation to be used,
- dissemination of emergency action plan to employees initially and whenever the plan changes,
- agreement with local medical facilities to treat injuries/illnesses;
- emergency equipment and supplies,
- personal injuries or illnesses,
- motor vehicle accidents and property damage, and
- site security and control.

12.4 Provisions for Public Health and Safety

Emergency planning is presented in the Laboratory's ES&H Manual (LANL 1990, 0335). The Laboratory identifies four situations in which hazardous materials may be released into the environment. These categories are founded in part on Emergency Response Planning Guideline (ERPG) concentrations developed by the American Industrial Hygiene Association and on the basis of the maximum concentration of toxic material that can be tolerated for up to 1 hour.

The types of emergencies are defined as follows:

- **Unusual event.** An event that has occurred or is in progress that normally would not be considered an emergency but that could reduce the safety of the facility. No potential exists for significant releases of radioactive or toxic materials off-site.
- **Site alert.** An event that has occurred or is in progress that would substantially reduce the safety level of the facility. Off-site releases of toxic materials are not expected to exceed the concentrations defined in ERPG-1.
- **Site emergency.** An event that has occurred or is in progress that involves actual or likely major failures of facility functions necessary for the protection of human health and the environment. Releases of toxic materials to areas off-site may exceed the concentrations described in ERPG-2.
- **General emergency.** An event that has occurred or is in progress that substantially interferes with the functioning of facility safety systems. Releases of radioactive materials to areas off-site may exceed protective response recommendations, and toxic materials may exceed ERPG-3.

12.5 Notification Requirements

Field team members will notify the SSO of emergency situations; the SSO will notify the appropriate emergency assistance personnel (e.g., fire, police, and ambulance), the OUPL, the HSPL, the Laboratory Health and Safety Division according to DOE Order 5500.2 (DOE 1991, 0736), and DOE Albuquerque Operations Office (AL) Order 5000.3 (DOE/AL 1991, 0734). The Laboratory Health and Safety Division is responsible for implementing notification and reporting requirements according to DOE Order 5484.1 (DOE 1990, 0773).

The names of persons and services to contact in case of emergencies are given in Table III-11. This emergency contact form will be copied and posted in prominent locations at the work site. Two-way radio communication will be maintained at remote sites when possible.

Table III-11

Emergency Contacts

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

The emergency contact number at the Laboratory is 9-911. Dialing 911 does work on Laboratory phones but it takes longer to get a response.

12.6 Documentation

An unusual occurrence is any deviation from the planned or expected behavior or course of events in connection with any DOE or DOE-controlled operation if the deviation has environmental, safety, or health protection significance. Examples of unusual occurrences include any substantial degradation of a barrier designed to contain radioactive or toxic materials or any substantial release of radioactive or toxic materials.

The Laboratory principal investigator will submit a completed DOE Form F 5484.X for any of the following accidents and incidents, according to Laboratory AR 1-1:

- **Occupational injury.** An injury such as a cut, fracture, sprain, or amputation that results from a work accident or from an exposure involving a single incident in the work environment. Note: Conditions resulting from animal bites, such as insect or snake bites, or from one-time exposure to chemicals are considered injuries.
- **Occupational illness.** Any abnormal condition or disorder, other than one resulting from an occupational injury, caused by exposure to environmental factors associated with employment. It includes acute and chronic illnesses or diseases that may be caused by inhalation, absorption, ingestion, or direct contact with a toxic material.
- **Property damage losses of $1,000 or more.** Regardless of fault, accidents that cause damage to DOE property or accidents, wherein DOE may be liable for damage to a second party, are reportable where damage is $1,000 or more, including damage to facilities, inventories, equipment, and properly parked motor vehicles but excluding damage resulting from a DOE-reported vehicle accident.
- **Government motor vehicle accidents with damages of $150 or more or involving an injury.** Unless the government vehicle is not at fault or the occupants are uninjured. Accidents are also reportable to DOE if:
    - damage to a government vehicle not properly parked is greater than or equal to $250;
    - damage to DOE property is greater than or equal to $500 and the driver of a government vehicle is at fault;
    - damage to any private property or vehicle is greater than or equal to $250 and the driver of a government vehicle is at fault; or

- any individual is injured and the driver of a government vehicle is at fault.

The HSPL will work with the OUPL and the field team leader to ensure that health and safety records are maintained with the appropriate Laboratory group, as required by DOE orders. The reports are as follows:

- DOE-AL Order 5000.3 (DOE 1990, 0253), Unusual Occurrence Reporting
- DOE Form 5484.3, Supplementary Record of Occupational Injuries and Illnesses, DOE Order 5484.1 (DOE 1990, 0733)
- DOE Form 5484.4, Tabulation of Property Damage Experience, Attachment 2, DOE Order 5484.1 (DOE 1990, 0733)
- DOE Form 5484.5, Report of Property Damage or Loss, Attachment 4, DOE Order 5484.1 (DOE 1990, 0733)
- DOE Form 5484.6, Annual Summary of Exposures Resulting in Internal Body Depositions of Radioactive Materials, DOE Order 5484.1 (DOE 1990, 0733)
- DOE Form 5484.8, Termination Occupational Exposure Report, Attachment 10, DOE Order 5484.1 (DOE 1990, 0733)
- DOE Form OSHA-200, Log of Occupational Injuries and Illnesses, Attachment 7, DOE Order 5484.1 (DOE 1990, 0733)
- DOE Form EV-102A, Summary of DOE and DOE Contractor Occupational Injuries and Illnesses, Attachment 8, DOE Order 5484.1 (DOE 1990, 0773)
- DOE Form F5821.1, Radioactive Effluent/Onsite Discharges/Unplanned Releases, Attachment 12, DOE Order 5484.1 (DOE 1990, 0773)

Copies of these reports will be stored with the appropriate Laboratory group. Specific reporting responsibilities are given in Chapter 1, General ARs, of the Laboratory ES&H Manual (LANL 1990, 0335).

13.0 PERSONNEL TRAINING

13.1 General Employee Training and Site Orientation

All Laboratory employees and supplemental workers must successfully complete Laboratory general employee training (GET). GET training is performed by the Health and Safety Division. The OUPL is responsible for scheduling GET training for supplemental workers.

Several types of training are required, including:

- OSHA-mandated,
- facility-specific,
- site-specific or pre-entry, and
- tailgate.

Site workers will receive each type of training during the course of field activities.

13.2 OSHA Requirements

OSHA's HAZWOPER standard (29 CFR 1910.120) regulates the health and safety of employees involved in HAZWOP. This standard requires training commensurate with the level and function of the employee. Persons shall not participate in field activities until they have been trained to a level required by their job function and responsibility. The SSO is responsible for ensuring that all persons entering the exclusion zone are properly trained.

13.2.1 Pre-Assignment Training

At the time of job assignment, all general site workers shall receive a minimum of 40 hours of initial instruction off-site and a minimum of 3 days of actual field experience under the direct supervision of a trained, experienced supervisor. Occasional site workers shall receive a minimum of 24 hours of initial instruction. Workers who may be exposed to unique or special hazards shall be provided additional training. The level of training provided shall be consistent with the employee's job function and responsibilities.

13.2.2 On-Site Management and Supervisors

On-site management and supervisors directly responsible for or who supervise employees engaged in HAZWOP shall receive at least 8 hours of additional specialized training on managing such operations at the time of job assignment.

13.2.3 Annual Refresher

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

13.2.4 Site-Specific Training

Prior to granting site access, personnel must be given site-specific training. Attendance and understanding of the site-specific training must be documented. A weekly health and safety briefing and periodic training (as warranted) will be given. Daily tailgate safety meetings will be used to update workers on changing site conditions and to reinforce safe work practices. Training should include the topics indicated in Table III-12 in accordance with 29 CFR 1910.120(i)(2)(ii).

Table III-12. Training topics

Initial site-specific	Weekly	Periodic as warranted	Subject
X		X	Site Health and Safety Plan, 29 CFR 1910.120(e)(1)
X		X	Site Characterization and Analysis, 29 CFR 1910.120(i)
X		X	Chemical Hazards, Table 1
X		X	Physical Hazards, Table 2
X		X	Medical Surveillance Requirements, 29 CFR 1910.120(f)
X	X		Symptoms of Overexposure to Hazards, 29 CFR 1910.120(e)(1)(vi)
X		X	Site Control, 29 CFR 1910.120(d)
X		X	Training Requirements, 29 CFR 1910.120(e)
X	X	X	Engineering and Work Practice Controls, 29 CFR 1910.120(g)
X	X	X	PPE, 29 CFR 1910.120(g), 29 CFR 1910.134
X	X	X	Respiratory Protection, 29 CFR 1910.120(g), 29 CFR 1910.134, ANSI Z88.2-1980
X		X	Overhead and Underground Utilities
X	X	X	Scaffolding, 29 CFR 1910.28(a)
X	X		Heavy Machinery Safety
X		X	Forklifts, 29 CFR 1910.27(d)
X		X	Tools
X		X	Backhoes, Front End Loaders
X		X	Other Equipment Used at Site
X		X	Pressurized Gas Cylinders, 29 CFR 1910.101(b)
X	X	X	Decontamination, 29 CFR 1910.120(k)

Initial site-specific	Weekly	Periodic as warranted	Subject
X		X	Air Monitoring, 29 CFR 1910.120(h)
X		X	Emergency Response Plan, 29 CFR 1910.120(l)
X	X		Handling Drums and Other Containers, 29 CFR 1910.120(j)
X		X	Radioactive Wastes
X		X	Explosive Wastes
X		X	Shock Sensitive Wastes
X		X	Flammable Wastes
X	X	X	Confined Space Entry
X			Illumination, 29 CFR 1910.120(m)
X	X	X	Buddy System, 29 CFR 1910.120(a)
X		X	Heat and Cold Stress
X		X	Animal and Insect Bites
X		X	Spill contaminant

13.3 Radiation Safety Training

Basic radiation worker training is required for all employees (radiation workers) (1) whose job assignments involve operation of radiation-producing devices, (2) who work with radioactive materials, (3) who are likely to be routinely occupationally exposed above 0.1 rem (0.001 sievert) per year, or (4) who require unescorted entry into a radiological area. This training is a 4-hour extension to GET for new employees.

Radiation protection training is required for all Laboratory employees, contractors, visiting scientists, and DOE and Department of Defense personnel. This is a 1-hour presentation as part of GET.

13.4 Hazard Communication

Laboratory employees shall be trained in accordance with Health and Safety Division requirements. Contractors shall provide training to their employees in compliance with 29 CFR 1910.120.

13.5 High Explosives Training

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

13.6 Facility-Specific Training

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

13.7 Records

Records of training shall be maintained by the Health and Safety Division and in the project file to confirm that every individual assigned to a task has had adequate training for that task and that every employee's training is up-to-date. The SSO or his designee is responsible for ensuring that persons entering the site are properly trained.

14. REFERENCES

American Industrial Hygiene Association, 1986. "Noise and Hearing Conservation Manual," Fourth Edition, Akron, Ohio.

Information Labor Organization, 1989. "Encyclopedia of Occupational Health and Safety," Third Edition, Volume I.

U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, "NIOSH Manual of Analytical Methods."

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American Conference of Governmental Industrial Hygienists, 1992. "Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, 1992-1993," Cincinnati, Ohio.

U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, October 1985. "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities," U.S. Government Printing Office, Washington, D.C.

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U.S. Department of Labor, Occupational Safety and Health Administration, March 1989. "Industrial Exposure and Control."

U.S. Department of Labor Occupational Safety and Health Administration, March 1989. "Industrial Exposure and Control: Technologies for OSHA-Regulated Hazardous Substances," Volumes I and II, Washington, D.C.

Attachment A

LEVELS OF PPE

Attachment A
Levels of PPE

Level of protection	Equipment	Protection provided	Should be used when:	Limiting criteria
A	Recommended: • Pressure-demand, full-facepiece SCBA or pressure-demand supplied-air respirator with escape SCBA • Fully encapsulating, chemical-resistant suit • Inner chemical-resistant gloves • Chemical-resistant safety boots/shoes • Two-way radio communications Optional: • Cooling unit • Coveralls • Long cotton underwear • Hard hat • Disposable gloves and boot covers	The highest available level of respiratory, skin, and eye protection	• The chemical substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system based on either: – measured (or potential for) high concentration of atmospheric vapors, gases, or particulates – site operations and work functions involving a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates of materials that are harmful to skin or capable of being absorbed through the intact skin • Substances with a high degree of hazard to the skin are known or suspected to be present, and skin contact is possible • Operations must be conducted in confined, poorly ventilated areas until the absence of conditions requiring Level A protection is determined	• Fully encapsulating suit material must be compatible with the substances involved

Level of protection	Equipment	Protection provided	Should be used when:	Limiting criteria
B	Recommended: • Pressure-demand, full facepiece SCBA or pressure-demand supplied-air respirator with escape SCBA • Chemical-resistant clothing (overalls and long-sleeved jacket; hooded, one- or two-piece chemical splash suit; disposable chemical-resistant one-piece suit) • Inner and outer chemical-resistant gloves • Chemical-resistant safety boots/shoes • Hard hat • Two-way radio communications Optional: • Coveralls • Disposable boot covers • Face shield • Long cotton underwear	The same level of respiratory protection but less skin protection than Level A It is the minimum level recommended for initial site entries until the hazards have been further identified	• The type and atmospheric concentration of substances have been identified and require a high level of respiratory protection but less skin protection. This involves atmospheres: – with IDLH concentrations of specific substances that do not represent a severe skin hazard – that do not meet the criteria for use of air-purifying respirators • Atmosphere contains less than 19.5% oxygen • Presence of incompletely identified vapors or gases is indicated by direct-reading organic vapor detection instrument, but vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the intact skin	• Use only when the vapor or gases present are not suspected of containing high concentrations of chemicals that are harmful to skin or capable of being absorbed through the intact skin • Use only when it is highly unlikely that the work being done will generate either high concentrations of vapors, gases, or particulates or splashes of material that will affect exposed skin

Level of protection	Equipment	Protection provided	Should be used when:	Limiting criteria
C	Recommended: • Full faceplece, air-purifying, canister-equipped respirator • Chemical-resistant clothing (overalls and long-sleeved jacket; hooded, one- or two-piece chemical splash suit; disposable chemical-resistant one-piece suit) • Inner and outer chemical-resistant gloves • Chemical-resistant safety boots/shoes • Hard hat • Two-way radio communications Optional: • Coveralls • Disposable boot covers • Face shield • Escape mask • Long cotton underwear	The same level of skin protection as Level B but a lower level of respiratory protection	• The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect any exposed skin • The types of air contaminants have been identified, concentrations measured, and a canister is available that can remove the contaminant • All criteria for the use of air-purifying respirators are met	• Atmospheric concentration of chemicals must not exceed IDLH levels • The atmosphere must contain at least 19.5% oxygen
D	Recommended: • Coveralls • Safety boots/shoes • Safety glasses or chemical splash goggles • Hard hat Optional: • Gloves • Escape mask • Face shield	No respiratory protection. Minimal skin protection	• The atmosphere contains no known hazard • Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals	• This level should not be worn in the exclusion zone • The atmosphere must contain at least 19.5% oxygen

Attachment B

COMMON CHEMICALS IN PHOTOGRAPHIC PROCESSING

Attachment B
Common Chemicals in Photographic Processing

Common Developer Constituents

Metol (4-methylaminophenol)- black and white developers
Hydroquinone- black and white developers
Paraphenylene diamine derivatives CD2, CD3, etc : developers used for color developing
Ethylene diamine: constituent of certain developers
Pentachlorophenol and Sodium pentachlorophenolate: preservatives for developers Potassium phosphate, potassium hydroxide, and p-phenylenediamine, diethylene glycol: developer

Common Bleaching Constituents

Acetic Acid, ammonium bromide, and potassium nitrate: bleach replenisher
Ammonium Bromide, hydrobromic acid, ammonium tetraacetoferrate(III), and potassium salt of ethylenediamine tetraacetic acid: bleaching agents
Sodium ethylene diamine tetra-actetate (Na EDTA) and sodium diethene triamine pentacetate: constituents in bleaching solutions

Common Cleaning Constituents

Concentrated Formaldehyde, chlorinated and fluorinated solvents (1,1,1-trichloroethane, methylene chloride, Freon, etc.): used for cleaning and in protective products
Hydrochloric acid: used for cleaning

Miscellaneous

Potassium dichromate: used in reversal solutions
Formaldehyde: used as a stabilizer
Ammonia: adjusts pH values
Hydrochloric acid: used for cleaning
Sodium ethylene diamine tetra-acetate (Na EDTA) and sodium diethene triamine pentacetate: constituents in bleaching solutions
tert-Butylaminoborane: exposure
Sodium hydrosulphite: reducing agents
Methanol
Potassium sulfite, ethylenediamine tetraacetic acid and 1-tyioglycerol: conditioner and replenishers

Sources:
Encyclopedia of Occupational Health and Safety
Processing constituent list from KODAK C-41
Processing constituent list from KODAK Ektachrome E-6
Safe Handling Considerations for the EKTAPRINT 3 PROCESS - KODAK

Annex IV

Records Management Project Plan

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Background Information for OU 1093

Chapter 3
Environmental Setting

Chapter 4
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Chapter 5
Evaluation of Potential Release Sites

Chapter 6
Potential Release Sites Proposed for No Further Action or Deferred Investigation

Annexes

Appendices

This work plan will follow the records management program plan provided in Annex IV of Revision 2 of the Installation Work Plan (LANL 1992, 0768). (This sentence is the complete text of Annex IV.)

REFERENCES FOR ANNEX IV

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

Annex V

Community Relations Project Plan

Executive Summary

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Annexes

Appendices

This work plan will follow the community relations program plan provided in Annex V of Revision 2 of the Installation Work Plan (LANL 1992, 0768). The ER Program's public reading room is located at 1450 Central Avenue, Suite 101, Los Alamos, New Mexico. The community relations project leader can be reached at (505) 665-5000 for additional information. (This paragraph is the complete text of Annex V.)

REFERENCES FOR ANNEX V

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

Executive Summary

Chapter 1
Introduction

Chapter 2
Background Information for OU 1093

Chapter 3
Environmental Setting

Chapter 4
Technical Approach

Chapter 5
Evaluation of Potential Release Sites

Chapter 6
Potential Release Sites Proposed for No Further Action or Deferred Investigation

Annexes

Appendices

Appendix A

List of Contributors

LIST OF CONTRIBUTORS TO RFI WORK PLAN FOR OU 1093

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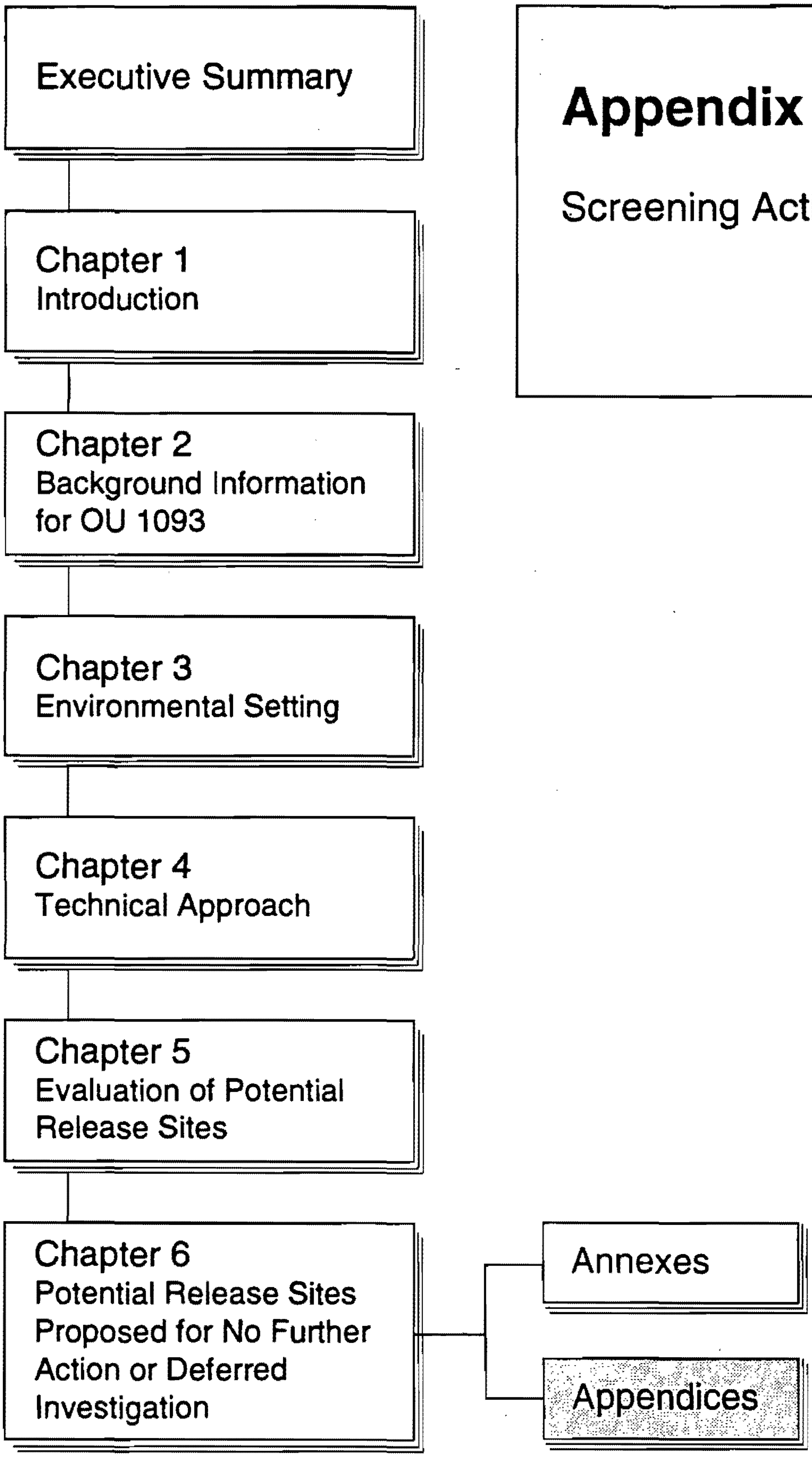
Appendix B

Screening Action Levels



This appendix presents derived screening action levels for chemical and metal constituents. Screening action levels for radiological constituents have not been formally proposed by the ER Program, but they are under development. The material in this appendix is taken directly from the 1922 IWP, Appendix J (LANL 1992, 0768).

TABLE B-1

SCREENING ACTION LEVELS FOR CHEMICAL ANALYTES IN SOIL, WATER, AND AIR FOR ENVIRONMENTAL CHARACTERIZATION OF LOS ALAMOS NATIONAL LABORATORY[a]

Listed Substances[b]	Chronic Oral RfD mg/kg-day	Oral Slope Factor (mg/kg-d)$^{-1}$ and Group[c]	Chronic Inhalation RfD mg/kg-d	Inhalation Slope Factor (mg/kg-d)$^{-1}$ and Group[c]	VF[k] m^3/kg	Soil Screening Action Level Systemic Toxicant mg/kg	Soil Screening Action Level Carcinogen mg/kg	Water Screening Action Level Systemic Toxicant µg/l	Water Screening Action Level Carcinogen µg/l	Air Screening Action Level Systemic Toxicant µg/m^3	Air Screening Action Level Carcinogen µg/m^3	CRQL[d] mg/kg and µg/l
Target Analyte List												
Aluminum[e], 7429-90-5												40, 200
Antimony, 7440-36-0	0.0004					32		14				12, 60[g]
Arsenic, 7440-38-2	0.0003[l]	1.75, A		15, A		24	0.40	11	0.02		0.00023	2, 10[g]
Barium, 7440-39-3	0.07		0.00014[f]			5,600		2,400		0.49		40, 200
Beryllium, 7440-41-7	0.005	4.3, B2		8.4, B2		400	0.16	170	0.0081		0.00042	1, 5[g]
Cadmium, 7440-43-9	0.001[m]			6.3, B1		80		35			0.00056	1, 5
Calcium[e], 7440-70-2												1000, 5000
Chromium III, 16065-83-1	1.0					80,000		35,000				2, 10
Chromium VI, 7440-47-3	0.005			42, A		400		170			0.000083	2, 10
Cobalt[e], 7440-48-4												10, 50
Copper, 7440-50-8	0.037[f]					3,000		1,300				5, 25
Cyanide, 57-12-5	0.02				8.2e+03	1,600		700				2, 10
Iron[e], 1543-83-10												20, 100
Lead[e], 7439-92-1												0.6, 3
Magnesium[e], 7786-30-3												1000, 5000
Manganese, 7439-96-5	0.1	ND, D	0.00011	ND, D		8,000		3,500		0.39		3, 15

TABLE B-1 (continued)

SCREENING ACTION LEVELS FOR CHEMICAL ANALYTES IN SOIL, WATER, AND AIR FOR ENVIRONMENTAL CHARACTERIZATION OF LOS ALAMOS NATIONAL LABORATORY[a]

Listed Substances[b]	Chronic Oral RfD mg/kg-day	Oral Slope Factor (mg/kg-d)-1 and Group[c]	Chronic Inhalation RfD mg/kg-d	Inhalation Slope Factor (mg/kg-d)-1 and Group[c]	VF[k] m^3/kg	Soil Screening Action Level Systemic Toxicant mg/kg	Soil Screening Action Level Carcinogen mg/kg	Water Screening Action Level Systemic Toxicant µg/l	Water Screening Action Level Carcinogen µg/l	Air Screening Action Level Systemic Toxicant µg/m^3	Air Screening Action Level Carcinogen µg/m^3	CRQL[d] mg/kg and µg/l
Mercury, 7439-97-6	0.0003[f]	ND, D	8.6e-5[f]	ND, D		24		11		0.30		0.04, 0.2
Nickel, 7440-02-0	0.02			0.84, A		1,600		700			0.0042	8, 40
Potassium[e], 7447-40-7												1000, 5000
Selenium, 7782-49-2	0.005					400		170				1, 5
Silver, 7440-22-4	0.005					400		170				2, 10
Sodium[e], 7647-14-5												1000, 5000
Thallium, 7440-28-0	0.00008[n]					6.4		2.8				2, 10[g]
Uranium[b], 7440-61-1	0.003					240		100				
Vanadium, 7440-62-2	0.007[f]					560		240				10, 50
Zinc, 7440-66-6	0.3[f]	ND, D		ND, D		24,000		10,000				4, 20
Target Compound List												
<u>Volatile Organic Compounds</u>												
Acetone, 67-64-1	0.1				1.4e+04	8,000		3,500				0.01, 10
Benzene, 71-43-2		0.029, A		0.029, A	5.7e+03		0.67[h]		1.2		0.12	0.01, 10[g]
Bromodichloromethane, 75-27-4	0.02	0.13, B2		ND, B2	8.0e+02	1,600	5.4	700	0.27			0.01, 10[g]

TABLE B-1 (continued)

SCREENING ACTION LEVELS FOR CHEMICAL ANALYTES IN SOIL, WATER, AND AIR FOR ENVIRONMENTAL CHARACTERIZATION OF LOS ALAMOS NATIONAL LABORATORY[a]

Listed Substances[b]	Chronic Oral RfD mg/kg-day	Oral Slope Factor $(mg/kg\text{-}d)^{-1}$ and Group[c]	Chronic Inhalation RfD mg/kg-d	Inhalation Slope Factor $(mg/kg\text{-}d)^{-1}$ and Group[c]	VF[k] m^3/kg	Soil Screening Action Level Systemic Toxicant mg/kg	Soil Screening Action Level Carcinogen mg/kg	Water Screening Action Level Systemic Toxicant µg/l	Water Screening Action Level Carcinogen µg/l	Air Screening Action Level Systemic Toxicant $\mu g/m^3$	Air Screening Action Level Carcinogen $\mu g/m^3$	CRQL[d] mg/kg and µg/l
Bromoform, 75-25-2	0.02	0.0079, B2		0.0039, B2		1,600	89	700	4.4		0.90	0.01, 10[g]
Bromomethane, 74-83-9	0.0014		0.0014		3.9e+02	0.43[h]		49		4.9		0.01, 10
2-Butanone (Methyl ethyl ketone), 78-93-3	0.05[f]		0.29		1.9e+04	2,100[h]		1,700		1,000		0.01, 10
Carbon disulfide, 75-15-0	0.1		0.0029[f]		3.2e+03	7.4[h]		3,500		10		0.01, 10
Carbon tetrachloride, 56-23-5	0.0007	0.13, B2		0.053, B2	3.3e+03	56	0.21[h]	25	0.27		0.066	0.01, 10[g]
Chlorobenzene, 108-90-7	0.02		0.0057[f]		1.5e+04	67[h]		700		20		0.01, 10
Chloroethane, 75-00-3			2.9		1.4e+03	3,300[h]				10,000		0.01, 10
Chloroform, 67-66-3	0.01	0.0061, B2		0.081, B2	4.8e+03	800	0.21[h]	350	5.7		0.043	0.01, 10[g]
Chloromethane, 74-87-3		0.013, C[f]		0.0063, C[f]	1.2e+03		6.4[h]		27		5.6	0.01, 10
Dibromochloromethane, 124-48-1	0.02	0.084, C		ND, C		1,600	83	700	4.2			0.01, 10[g]
1,1-Dichloroethane, 75-34-3	0.1[f]	ND, C	0.14[f]	ND, C	3.8e+03	410[h]		3,500		500		0.01, 10
1,1-Dichloroethene, 75-35-4	0.009	0.6, C		0.12, C	2.1e+03	720	0.59[h]	310	0.58		0.29	0.01, 10[g]
1,2-Dichloroethane, 107-06-2		0.091, B2		0.091, B2	5.5e+03		0.20[h]		0.38		0.038	0.01, 10[g]
1,2-Dichloroethene (total), 540-59-0	0.01[f,i]				4.6e+03	800		350				0.01, 10
1,2-Dichloropropane, 78-87-5		0.068, B2[f]	0.0011	ND, B2[f]	7.1+03	6.5[h]	10		0.51	4.0		0.01, 10[g]

TABLE B-1 (continued)

SCREENING ACTION LEVELS FOR CHEMICAL ANALYTES IN SOIL, WATER, AND AIR FOR ENVIRONMENTAL CHARACTERIZATION OF LOS ALAMOS NATIONAL LABORATORY[a]

Listed Substances[b]	Chronic Oral RfD mg/kg-day	Oral Slope Factor (mg/kg-d)$^{-1}$ and Group[c]	Chronic Inhalation RfD mg/kg-d	Inhalation Slope Factor (mg/kg-d)$^{-1}$ and Group[c]	VF[k] m^3/kg	Soil Screening Action Level Systemic Toxicant mg/kg	Soil Screening Action Level Carcinogen mg/kg	Water Screening Action Level Systemic Toxicant µg/l	Water Screening Action Level Carcinogen µg/l	Air Screening Action Level Systemic Toxicant µg/m^3	Air Screening Action Level Carcinogen µg/m^3	CRQL[d] mg/kg and µg/l
cis-1,3-Dichloropropene, 10061-01-5	0.0003	0.18, B2[f]	0.0057	0.13, B2[f]	6.8+03	14[h]	0.17[h]	11	0.19	20	0.027	0.01, 10[g]
trans-1,3-Dichloropropene, 10061-02-6	0.0003	0.18, B2[f]	0.0057	0.13, B2[f]	6.8+3	14[h]	0.17[h]	11	0.19	20	0.027	0.01, 10[g]
Ethyl benzene, 100-41-4	0.1	ND, D	0.29	ND, D	2.2e+04	3,100[h]		3,500		1000		0.01, 10
2-Hexanone[e], 591-78-6					5.5e+04							0.01, 10
4-Methyl-2-pentanone (MIK), 108-10-1	0.05[f]		0.023[f]		3.2e+04	510[h]		1,700		80		0.01, 10
Methylene Chloride, 75-09-2	0.06	0.0075, B2	0.86[f]	0.0016, B2	2.9e+03	1,400[h]	5.6[h]	2,100	4.7	3000	2.2	0.01, 10[g]
Styrene, 100-42-5	0.2				1.8e+04	16,000		7,000				0.01, 10[g]
1,1,2,2-Tetrachloroethane, 79-34-5		0.2, C		0.2, C	2.9e+04		3.9[h]		1.8		0.18	0.01, 10[g]
Tetrachloroethene, 127-18-4	0.01	0.052, B-C[o]		0.002, B-C[o]	6.0e+03	800	5.9[h]	350	0.67		1.8	0.01, 10[g]
Toluene, 108-88-3	0.2	ND, D	0.40	ND, D	1.1e+04	890[h]		7,000		380		0.01, 10
1,1,1-Trichloroethane, 71-55-6	0.09[f]	ND, C	0.29[f]	ND, C	5.1e+03	1,000[h]		3,100		1,000		0.01, 10
1,1,2-Trichloroethane, 79-00-5	0.004	0.057, C		0.056, C	1.1e+04	320	6.3[h]	140	6.1		0.63	0.01, 10[g]
Trichloroethene, 79-01-6		0.011, B-C[o]		0.006, B-C[o]	5.8e+03		3.2[h]		3.2		0.58	0.01, 10[g]
Vinyl Chloride, 75-01-4		1.9, A[f]		0.294, A[f]	1.1e+03		0.013[h]		0.018		0.012	0.01, 10[g]
Xylenes (Total), 1330-20-7	2				9.6e+03	160,000		70,000				0.01, 10

TABLE B-1 (continued)

SCREENING ACTION LEVELS FOR CHEMICAL ANALYTES IN SOIL, WATER, AND AIR FOR ENVIRONMENTAL CHARACTERIZATION OF LOS ALAMOS NATIONAL LABORATORY[a]

Listed Substances[b]	Chronic Oral RfD mg/kg-day	Oral Slope Factor $(mg/kg\text{-}d)^{-1}$ and Group[c]	Chronic Inhalation RfD mg/kg-d	Inhalation Slope Factor $(mg/kg\text{-}d)^{-1}$ and Group[c]	VF[k] m^3/kg	Soil Screening Action Level Systemic Toxicant mg/kg	Soil Screening Action Level Carcinogen mg/kg	Water Screening Action Level Systemic Toxicant µg/l	Water Screening Action Level Carcinogen µg/l	Air Screening Action Level Systemic Toxicant $\mu g/m^3$	Air Screening Action Level Carcinogen $\mu g/m^3$	CRQL[d] mg/kg and µg/l
<u>Semi-Volatile Organic Compounds</u>												
Acenaphthene, 83-32-9	0.06				3.4e+05	4,800		2,100				0.33, 10
Acenaphthylene[e], 208-96-8					6.1e+04							0.33, 10
Anthracene, 120-12-7	0.3				1.8e+05	24,000		10,000				0.33, 10
Benzo[a]anthracene[e], 56-55-3		ND, B2		NA, B2								0.33, 10
Benzo[b]fluoranthene[e]205-99-2		ND, B2		ND, B2								0.33, 10
Benzo[k]fluoranthene[e], 207-08-9		ND, B2		ND, B2								0.33, 10
Benzo[ghi]perylene[e], 191-24-2		ND, D		ND, D								0.33, 10
Benzo[a]pyrene, 50-32-8		7.3, B2		6.1, B2[f]			0.10		0.0048		0.00057	0.33, 10[g]
Bis(2chloroethoxy)methane[e], 111-91-1		ND, D		ND, D								0.33, 10
Bis-(2-chloroethyl)ether, 111-44-4		1.1, B2		1.1, B2	4.9e+04		0.13[h]		0.032		0.0032	0.33, 10[g]
Bis(2-ethylhexyl)phthalate, 117-81-7	0.02	0.014, B2		ND, B2		1,600	50	700	2.5			0.33, 10[g]
4-Bromophenyl-phenylether, 101-55-3												0.33, 10
Butyl benzyl phthalate, 85-68-7	0.2	ND, C		ND, C		16,000		7,000				0.33, 10
Carbazole, 86-74-8		0.02, B2[f]		ND, B2[f]			35		1.8			0.33, 10

TABLE B-1 (continued)

SCREENING ACTION LEVELS FOR CHEMICAL ANALYTES IN SOIL, WATER, AND AIR FOR ENVIRONMENTAL CHARACTERIZATION OF LOS ALAMOS NATIONAL LABORATORY[a]

Listed Substances[b]	Chronic Oral RfD mg/kg-day	Oral Slope Factor (mg/kg-d)$^{-1}$ and Group[c]	Chronic Inhalation RfD mg/kg-d	Inhalation Slope Factor (mg/kg-d)$^{-1}$ and Group[c]	VF[k] m^3/kg	Soil Screening Action Level Systemic Toxicant mg/kg	Soil Screening Action Level Carcinogen mg/kg	Water Screening Action Level Systemic Toxicant µg/l	Water Screening Action Level Carcinogen µg/l	Air Screening Action Level Systemic Toxicant µg/m^3	Air Screening Action Level Carcinogen µg/m^3	CRQL[d] mg/kg and µg/l
4-Chloroaniline, 106-47-8	0.004					320		140				0.33, 10
4-Chloro-3-methylphenol (p-chloro-m-cresol), 59-50-7	2[f, j]					160,000		70,000				0.33, 10
2-Chloronaphthalene, 91-58-7	0.08				1.4e+05	6,400		2,800				0.33, 10
2-Chlorophenol, 95-57-8	0.005					400		170				0.33, 10
4-Chlorophenyl phenyl ether[e], 7005-72-3												0.33, 10
Chrysene[e], 218-01-9		ND, B2		ND, B2								0.33, 10
Dibenz[a,h]anthracene[e], 53-70-3		ND, B2		ND, B2								0.33, 10
Dibenzofuran[e], 132-64-9												0.33, 10
Di-n-butylphthalate, 84-74-2	0.1	ND, D		ND, D		8,000		3,500				0.33, 10
1,2-Dichlorobenzene, 95-50-1	0.09		0.057[f]		4.5e+04	1,600[h]		3,100		200		0.33, 10
1,3-Dichlorobenzene[e], 541-73-1					3.3e+04							0.33, 10
1,4-Dichlorobenzene, 106-46-7		0.024, C[f]	0.2[f]	ND, C	3.6e+04	5,800[h]	290		15	700		0.33, 10
3,3-Dichlorobenzidine, 91-94-1		0.45, B2		ND, B2			1.6		0.078			0.33, 10[g]
2,4-Dichlorophenol, 120-83-2	0.003					240		100				0.33, 10
Diethylphthalate, 84-66-2	0.8					64,000		28,000				0.33, 10
2,4-Dimethylphenol, 105-67-9	0.02			ND, D	1.1e+05	1,600		700				0.33, 10
Dimethyl phthalate, 131-11-3	1[f]	ND, D		ND, D		80,000		35,000				0.33, 10

TABLE B-1 (continued)

SCREENING ACTION LEVELS FOR CHEMICAL ANALYTES IN SOIL, WATER, AND AIR FOR ENVIRONMENTAL CHARACTERIZATION OF LOS ALAMOS NATIONAL LABORATORY[a]

Listed Substances[b]	Chronic Oral RfD mg/kg-day	Oral Slope Factor (mg/kg-d)$^{-1}$ and Group[c]	Chronic Inhalation RfD mg/kg-d	Inhalation Slope Factor (mg/kg-d)$^{-1}$ and Group[c]	VF[k] m^3/kg	Soil Screening Action Level Systemic Toxicant mg/kg	Soil Screening Action Level Carcinogen mg/kg	Water Screening Action Level Systemic Toxicant µg/l	Water Screening Action Level Carcinogen µg/l	Air Screening Action Level Systemic Toxicant µg/m^3	Air Screening Action Level Carcinogen µg/m^3	CRQL[d] mg/kg and µg/l
4,6-Dinitro-2-methylphenol[e] (4,6-dinitro-o-cresol), 534-52-1												0.8, 25
2,4-Dinitrophenol, 51-28-5	0.002					160		70				0.8, 25
2,4-Dinitrotoluene, 121-14-2		0.68, B2		ND, B2			1.0		0.051			0.33, 10[g]
2,6-Dinitrotoluene, 606-20-2		0.68, B2		ND, B2			1.0		0.051			0.33, 10[g]
Di-n-octyl phthalate, 117-84-0	0.02[f]					1,600		700				0.33, 10
Fluoranthene, 206-44-0	0.04					3,200		1,400				0.33, 10
Fluorene, 86-73-7	0.04				5.1e+05	3,200		1,400				0.33, 10
Hexachlorobenzene, 118-74-1	0.0008	1.6, B2		1.6, B2		64	0.44	28	0.022		0.0022	0.33, 10[g]
Hexachlorobutadiene, 87-68-3	0.002	0.078, C		0.077, C		160	90	70	4.5		0.45	0.33, 10[g]
Hexachlorocyclopentadiene, 77-47-4	0.007		0.00002[f]			560		240		0.07		0.33, 10
Hexachloroethane, 67-72-1	0.001	0.014, C		0.014, C		80	500	35	25		2.5	0.33, 10
Indeno[1,2,3-cd]pyrene[e], 193-39-5		ND, B2		ND, B2								0.33, 10
Isophorone, 78-59-1	0.2	0.00095		ND, C		16,000	7,400	7,000	370			0.33, 10
2-Methylnaphthalene[e], 91-57-6					1.9e+05							0.33, 10
2-Methylphenol (o-cresol), 95-48-7	0.05	ND, C		ND, C		4,000		1,700				0.33, 10
4-Methylphenol (p-cresol), 106-44-5	0.05[f]	ND, C		ND, C		4,000		1,700				0.33, 10

TABLE B-1 (continued)

SCREENING ACTION LEVELS FOR CHEMICAL ANALYTES IN SOIL, WATER, AND AIR FOR ENVIRONMENTAL CHARACTERIZATION OF LOS ALAMOS NATIONAL LABORATORY[a]

Listed Substances[b]	Chronic Oral RfD mg/kg-day	Oral Slope Factor $(mg/kg\text{-}d)^{-1}$ and Group[c]	Chronic Inhalation RfD mg/kg-d	Inhalation Slope Factor $(mg/kg\text{-}d)^{-1}$ and Group[c]	VF[k] m^3/kg	Soil Screening Action Level Systemic Toxicant mg/kg	Soil Screening Action Level Carcinogen mg/kg	Water Screening Action Level Systemic Toxicant µg/l	Water Screening Action Level Carcinogen µg/l	Air Screening Action Level Systemic Toxicant $\mu g/m^3$	Air Screening Action Level Carcinogen $\mu g/m^3$	CRQL[d] mg/kg and µg/l
Naphthalene, 91-20-3	0.04[f]				6.8e+04	3,200		1,400				0.33, 10
2-Nitroaniline, (o-nitroaniline) 88-74-4	6.0e-05[f]		5.7e-05[f]			4.8		2.1		0.20		
3-Nitroaniline(m-nitroaniline)[e], 99-09-2												0.8, 25
4-Nitroaniline(p-nitroaniline)[e], 100-01-6												0.8, 25
Nitrobenzene, 98-95-3	0.0005	ND, D	0.00057[f]	ND, D	1.3e+04	5.3[h]		18		2.0		0.33, 10
2-Nitrophenol[e], 88-75-5												0.33, 10
4-Nitrophenol[e], 100-02-7					1.9e+04							0.8, 25
N-Nitrosodiphenylamine, 86-30-6		0.0049, B2		ND, B2			140		7.1			0.33. 10[g]
N-Nitroso-di-N-dipropylamine, 621-64-7		7, B2		ND, B2			0.10		0.0050			0.33, 10[g]
2,2-Oxybis(1-chloropropane) (bis[2-chloroisopropyl]ether), 108-60-1	0.04	0.07[f], C		0.035, C[f]		3,200	100	1,400	0.50		1.0	0.33, 10
Pentachlorophenol, 87-86-5	0.03	0.12, B2		ND, B2		2,400	5.8	1,000	0.29			0.8, 25[g]
Phenanthrene[e], 85-01-8					4.4e+05							0.33, 10
Phenol, 108-95-2	0.6					48,000		21,000				0.33, 10
Pyrene, 129-00-0	0.03					2,400		1,000				0.33, 10

TABLE B-1 (concluded)

SCREENING ACTION LEVELS FOR CHEMICAL ANALYTES IN SOIL, WATER, AND AIR FOR ENVIRONMENTAL CHARACTERIZATION OF LOS ALAMOS NATIONAL LABORATORY[a]

Listed Substances[b]	Chronic Oral RfD mg/kg-day	Oral Slope Factor (mg/kg-d)$^{-1}$ and Group[c]	Chronic Inhalation RfD mg/kg-d	Inhalation Slope Factor (mg/kg-d)$^{-1}$ and Group[c]	VF[k] m^3/kg	Soil Screening Action Level Systemic Toxicant mg/kg	Soil Screening Action Level Carcinogen mg/kg	Water Screening Action Level Systemic Toxicant µg/l	Water Screening Action Level Carcinogen µg/l	Air Screening Action Level Systemic Toxicant µg/m^3	Air Screening Action Level Carcinogen µg/m^3	CRQL[d] mg/kg and µg/l
1,2,4-Trichlorobenzene, 120-82-1	0.01		0.0026[f]		9.5e+04	160[h]		350		9.0		0.33, 10
2,4,5-Trichlorophenol, 95-95-4	0.10					8,000		3,500				0.8, 25
2,4,6-Trichlorophenol, 88-06-2		0.011, B2		0.011, B2			64		3.2		0.32	0.33, 10[g]

a. Screening action levels based on methodologies given by EPA (1990, 0432; EPA 1991, 0778). Reference dose (RfD) and slope factor data obtained from EPA (1992, 0830), unless otherwise noted. Screening action levels are rounded to two significant figures. Water screening action levels are used for both groundwater and surface water. ND = not determined.

b. Target Analyte List (TAL) and Target Compound List (TCL) and CAS numbers, as given by EPA (1991, 0778; 0779). Uranium has also been included because it is expected to be a contaminant of concern in some areas.

c. Carcinogens grouped as follows: Group A—human carcinogen; Group—B probable human carcinogen; Group C—possible human carcinogen; Group D—not classifiable as to human carcinogenicity.

d. Contract-Required Quantitation Limits (CRQLs) for soil and water, respectively. For TAL substances, CRQL for soil is obtained by multiplying water CRQL by 0.2. For TCL substances, the soil CRQL given is for low soil samples (wet weight). CRQLs not available for air.

e. Toxicity data (e.g., RfDs and/or slope factors) were not available; therefore, screening action levels were not calculated.

f. Toxicity data obtained from EPA (1992, 0833).

g. The screening action level is less than the CRQL; therefore, special analytical services may be required.

h. Soil screening action level incorporates inhalation pathway [only for substances with both an inhalation RfD or slope factor and a volatilization factor (VF) listed]. See below for equation.

i. Oral RfD for cis-1,2-dichloroethene used.

j. Subchronic RfD; chronic RfD for 4-chloro-3-methylphenol not available.

k. Soil-to-air volatilization factor; calculated based on equation given by EPA (1991, 0778) and chemical-specific parameters given in Strenge and Peterson (1989, 0777) and EPA (1988; 0747). VF is given only for substances with molecular weight less than 200 and Henry's Law constant greater than 10^{-5}atm/m^3-mole.

l. Oral RfD for arsenic taken from EPA (1992, 0830).

m. Oral RfD for cadmium in food/solids.

n. Oral RfD for thallium (I) sulfate.

o. Values obtained from the Superfund Health Risk Technical Support Center, Cincinnati, Ohio, October 1992.

General equations for calculation of screening action levels

Systemic Toxicants

SAL = (THI x RfD x BW x CF)/(I x A), where

SAL = soil screening action level (mg/kg for soil SALs; µg/L for water SALs; µg/m^3 for air SALs).
THI = target hazard index; 1.
RfD = chronic reference dose (mg/kg/day); oral RfD used for soil and water SALs; inhalation RfD used for air SAL.
BW = body weight; 16 kg for child (used for soil SAL); 70 kg for adult (used for water and air SALs).
CF = conversion factor; 10^6 mg/kg for soil SAL; 1000 ug/mg for water and air SALs.
I = intake assumption; 200 mg/day for soil SAL (child); 2 L/day for water SAL; 20 m^3/day for air SAL.
A = absorption factor; 1.

Carcinogenic Constituents

SAL = (R x BW x LT x CF)/(SF x I x A x ED), where

R = target risk; 10^{-6} for Class A and B carcinogens; 10^{-5} for Class C carcinogens.
BW = body weight; 70 kg.
LT = assumed lifetime; 70 yr.
CF = conversion factor; 10^6 mg/kg for soil SAL; 1000 µg/mg for water and air SALs.
SF = slope factor $(mg/kg/day)^{-1}$; oral SF used for soil and water SALs; inhalation SF used for air SALs.
I = intake assumption; 100 mg/day for soil SAL; 2 L/day for water SAL; 20 m^3/day for air SAL.
A = absorption factor; 1.
ED = exposure duration; 70 yr.

Equations for calculation of soil screening action levels for volatile contaminants

Systemic Toxicants

SAL = $(THI \times BW)/((1/RfD_o \times 10^{-6}\ kg/mg \times ING) + (1/RfD_i \times INH \times (1/VF + 1/PEF))$,

where

THI = target hazard index; 1.
BW = body weight; 16 kg.
RfD_o = chronic oral reference dose (mg/kg/day).

RfD_i = chronic inhalation reference dose (mg/kg/day).
ING = ingestion intake assumption; 200 mg/day.
VF = soil-to-air volatilization factor (m^3/kg; chemical-specific).
INH = inhalation intake assumption; 20 m^3/day.
PEF = particulate emission factor (4.63×10^9 m^3/kg;) (EPA 1992, 0833).

Carcinogens

SAL = $(R \times BW \times LT)/ED \times [(SF_o \times 10^{-6}\ kg/mg \times ING) + (SF_i \times INH \times (1/VF + 1/PEF))]$,

where

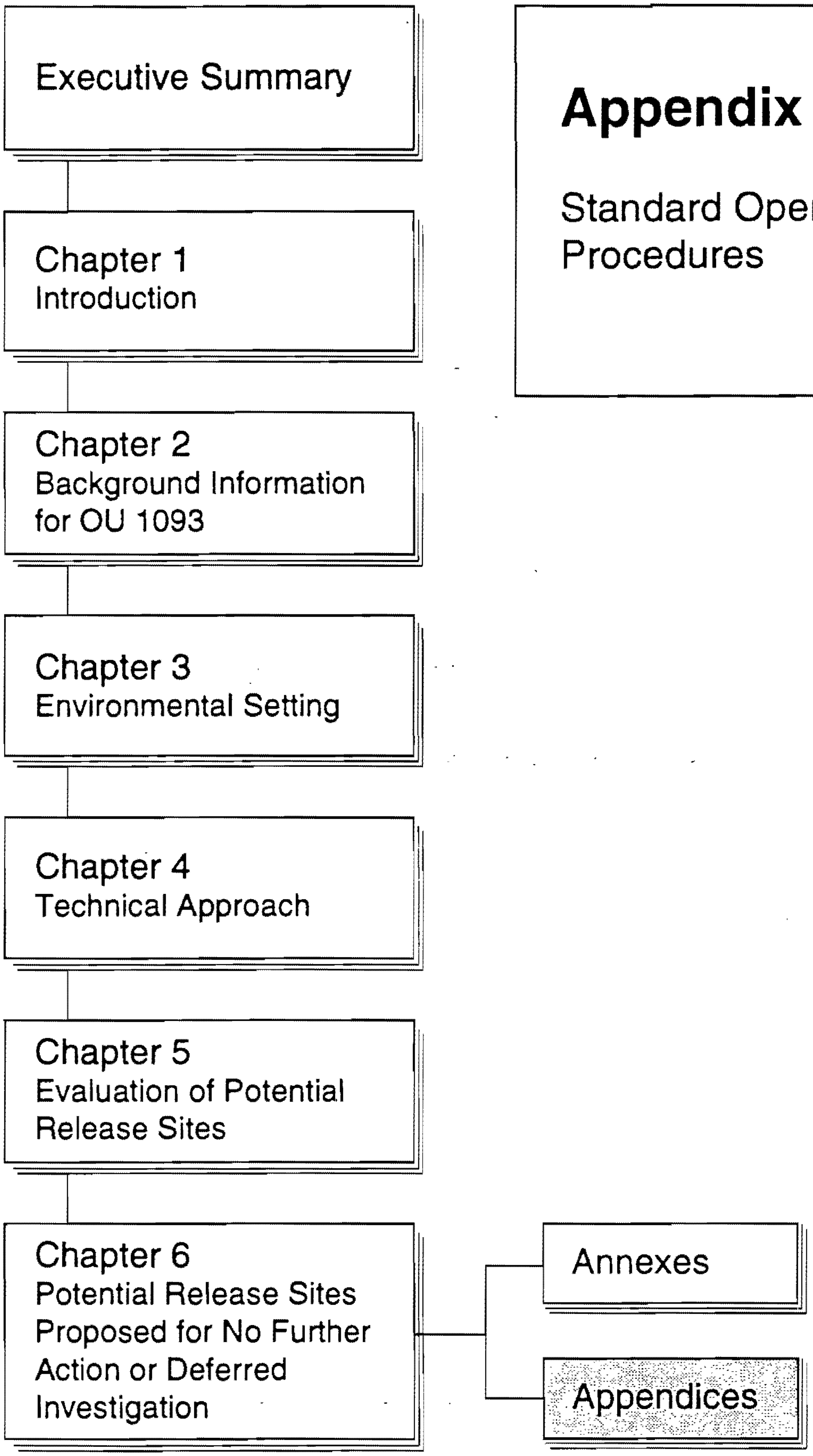
R = target risk; 10^{-6} for Class A and B carcinogens; 10^{-5} for Class C carcinogens.
BW = body weight; 70 kg.
LT = assumed lifetime; 70 yr.
ED = exposure duration; 70 yr.
SF_o = oral slope factor $(mg/kg/day)^{-1}$.
ING = ingestion intake assumption; 100 mg/day.
SF_i =inhalation slope factor $(mg/kg/day)^{-1}$.
INH = inhalation intake assumption; 20 m^3/day.
VF and PEF as defined above.

REFERENCES FOR APPENDIX B

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

Appendix C

Standard Operating Procedures



STANDARD OPERATING PROCEDURES

The standard operating procedures (SOPs) included in this appendix have not been approved by the Laboratory's Environmental Restoration (ER) Program. The SOPs have been acquired from a variety of sources, including Weston (adopted informally by the Laboratory for RCRA facility investigation (RFI) field work at TA-21); from ICF Kaiser Engineers; and from various Laboratory programs other than the ER Program. These procedures will be revised, as necessary, in response to review comments, and submitted for formal adoption by the ER Program before field work on OU 1093 is initiated.

DRAFT PROCEDURE C-1

COLLECTION AND RADIOLOGICAL SCREENING
OF
WIPE SAMPLES FROM SURFACES

STANDARD OPERATING PROCEDURE 1.7

SAMPLING FOR REMOVABLE ALPHA CONTAMINATION

1. PURPOSE

To describe a method of verifying that equipment leaving a controlled area that contains radioactive materials meets unrestricted release criteria for removable contamination. This equipment may include tools, vehicles, and miscellaneous items brought into contact with radioactive materials.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information on the scope of a given operation, related health and safety requirements, and the applicability of this procedure to the activities.

During the course of sampling in a radiologically contaminated area, various pieces of equipment handled by workers may become contaminated. To ensure safety for workers and compliance with the equipment release criteria set forth in the Health and Safety Plan section of the FSP or WP, equipment must be analyzed for removable contamination. Equipment must be decontaminated to levels that are as low as reasonably achievable--below the applicable release criterion for removable contamination in all cases. Release criteria in draft DOE Order 5480.11 are taken from guidelines provided in the U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 1.86. The most restrictive limit applies to transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, and I-129 and is 20 disintegrations per minute (dpm)/100 cm^2 above background for removable contamination. This limit may be used as a default value if alpha emitters are present and the applicable limit is unknown.

The standard technique for verification is to wipe (swipe) an area on a piece of equipment and analyze the swipe sample for elevated levels of radioactivity. A gross-alpha count is performed with an alpha sample counter connected to a portable scaler.

It may also be necessary to take direct instrument measurements with portable alpha scintillators or Geiger-Mueller detectors. A comparison of swipe results and direct instrument readings will distinguish between amounts of removable and total contamination.

3. PROCEDURE

3.1. Associated Procedures

Information that applies to most field activities is provided in SOPs 1.1-1.10. In addition to the FSP or WP, those SOPs provide guidance that may supplement the information in this procedure. They should be consulted as necessary to obtain specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
6.4	Total Alpha Surface Contamination Measurements
6.11	Beta-Gamma Radiation Measurements Using a Geiger-Mueller Detector

3.2. Preparation

3.2.1 Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Arrange for a laboratory counting system and personnel to perform the desired radiological analysis of swipes onsite.

E. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all field equipment.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate data collection forms (see INDEX TO SOPs).

3.2.3. Field

A. Complete the Daily Alpha Efficiency Check form (Appendix 5.2) by following instructions in Appendix 5.4, Data Form Completion.

B. Perform a 10-min background count and a 1-min NBS-traceable alpha source count daily when using the instrument. Record the results on the Daily Alpha Efficiency Check form (Appendix 5.2) and under <u>efficiency</u> on the Removable Alpha Contamination Survey Data form (Appendix 5.3). The efficiency is calculated as shown below.

$$\text{Efficiency} = \frac{\text{net source counts per minute (cpm) - background cpm}}{\text{source dpm}}$$

Any significant deviation of the efficiency from previous days or from the average may be a signal that the instrument is malfunctioning and should be investigated. Any significant increase in the 10-min background count usually indicates that the probe is contaminated and should be cleaned thoroughly.

3.3. Operation

3.3.1 Swipe Test

A. Label all swipe envelopes with the date, time, description or number of the item swiped, the location, and the initials of the person who collected the swipe sample. Make sure a sufficient number of swipes are available for the desired tasks.

B. If swipes are to be taken in a controlled area, wear appropriate protective clothing. Consult the Health and Safety Plan for the level of protection.

C. Obtain swipes from an area of 100 cm^2 when possible, noting the area swiped or surveyed in cm^2 on the Removable Alpha Contamination Survey Data form (Appendix 5.2). When it is not possible to cover this area, make an estimate of the surface area (in cm^2). For convenience, 100 cm^2 can be approximated by a square that is 4 inches on each side. If contamination is detected on a swipe taken from an area greater than 100 cm^2, the area must be reswiped in 100 cm^2 increments to ensure that a hot spot in excess of the limit is not present.

D. Use sufficient pressure on the swipe to pick up loose contamination without tearing or separating the swipe. Rough surfaces like concrete, cast iron, and rough-cut lumber should be surveyed according to SOP 6.4, Total Alpha Surface Contamination Measurements, and 6.11, Beta-Gamma Radiation Measurements Using a Geiger-Mueller Detector.

E. During routine swipe surveys, pay particular attention to areas on equipment where contamination is most likely to occur (for example, handles, footrests, and tires).

E. Return the swipe to a properly labeled glassine envelope. Maintain the swipe integrity and ensure that the sample material is not dislodged from the swipe.

G. Count each swipe with the alpha sample counter and scaler by inserting the swipe into the slide tray, closing the tray, and starting a 1-min count. This time may have to be decreased for swipes with high activity. Any swipe that appears to exceed the release criterion should be counted more than once for confirmation. Release criteria are described in Appendix 5.5, Limits for Removable Surface Contamination.

H. Record all results on the Removable Alpha Contamination Survey Data form (Appendix 5.3) according to instructions in Appendix 5.4, Data Form Completion.

I. Give the survey results to the personnel responsible for releasing equipment. Save any swipes that exceed the removable contamination limit in case a recount or additional analysis is needed. Equipment that fails to meet the release limits must undergo additional decontamination according to SOP 1.6, General Equipment Decontamination, and must be resurveyed.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Return all equipment to the storage area. Be certain the ratemeter/scaler is in the off position.

C. Equipment that fails to meet the release criteria after repeated decontamination efforts must be held from unrestricted release.

D. Make sure that swiped items are properly numbered or marked and identifications are readily visible and permanent.

3.4.2. Documentation

A. Record any uncompleted work (like uncounted swipes or items needing decontamination) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the document control officer (with copies to the site manager and files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Ensure that all radiological sources and standards have been stored in a locked area.

4. SOURCE

U.S. Nuclear Regulatory Commission. 1974. Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors." Washington, D.C.: U.S. Government Printing Office.

5. APPENDIXES

5.1 Equipment and Supplies Checklist

5.2 Daily Alpha Efficiency Check Form

5.3 Removable Alpha Contamination Survey Data Form

5.4 Data Form Completion

5.5 Limits for Removable Surface Contamination

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

________ Round swipe pads, 2-inch diameter

________ Sample holders or glassine envelopes

________ Indelible marker

________ Latex gloves

________ Alpha detector, Ludlum model 43-10 or the equivalent

________ Portable scaler (Ludlum 2200 or the equivalent) and connecting cable

________ Forceps (for handling contaminated swipes)

________ NBS-traceable alpha source, like Am-241

________ Hand-held calculator

APPENDIX 5.4

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

DAILY ALPHA EFFICIENCY CHECK FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.
2. Field Rep. The name of the field representative.
3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.
4. Acceptance Code. One-character code assigned by the site manager.
5. Ratemeter/Scaler Model No. The model number of the ratemeter/scaler.
6. Ratemeter/Scaler Serial No. The serial number of the ratemeter/scaler.
7. Ratemeter/Scaler Calibration Date. The date when the ratemeter/scaler was last calibrated.
8. Window. The window is in the out position unless otherwise specified.
9. Threshold. The adjustment for the lower energy level of the discriminator shown on the calibration sticker.
10. High Voltage. The voltage that is applied to the detector shown on the calibration sticker.
11. Battery. The battery voltage reading at the beginning of the measurement.
12. Probe Model No. The model number of the alpha scintillation probe.
13. Probe Serial No. The serial number of the alpha scintillation probe.
14. Probe Calibration Date. The date when the alpha scintillation probe was last calibrated.
15. Source Serial No. The serial number of the radiation source.
16. Source Isotope. The radioactive isotope contained in the source and given as an element and mass number, like Am-241.

17. Source Activity. The activity of the radioactive source. An activity given in microcuries (μCi) can be converted to disintegrations per minute (dpm) using 2.22×10^6 dpm = 1 μCi.

18. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

19. Time (HH:MM). The time the efficiency was determined using the 24-hr clock in the format hours:minutes.

20. Counting Time (Min). The time in minutes over which the scaler counts. Enter NA if using a ratemeter.

21. Background cpm. The count rate resulting from the 10-min background count.

$$\text{Background counts per minute (cpm)} = \frac{\text{10-min background count}}{10}$$

22. Gross Counts. The number of pulses recorded by the ratemeter/scaler during the 1-min source-counting time. Enter NA if using a ratemeter.

23. Gross cpm. The gross count rate of the source given in pulses per minute.

24. Net cpm. This is equal to the gross cpm minus the background cpm.

25. Efficiency (Net cpm/dpm). The ratio of the observed net count rate to the true disintegration rate (dpm).

$$\text{Efficiency} = \frac{\text{Net cpm}}{\text{Source dpm}}$$

ALPHA CONTAMINATION SURVEY DATA FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

4. Field Rep. The name of the field representative.

5. Acceptance Code. One-character code assigned by the site manager.

6. Ratemeter/Scaler Model No. The model number of the ratemeter/scaler.

7. Ratemeter/Scaler Serial No. The serial number of the ratemeter/scaler.

8. Ratemeter/Scaler Calibration Date. The date when the ratemeter/scaler was last calibrated.

9. Window. The window will be in the out position unless otherwise specified.

10. Threshold. The adjustment for the lower energy level of the discriminator. This is determined during calibration before instrument use in the field.

11. High Voltage. The voltage that is applied to the detector. The operating voltage for an alpha detector is typically 500 to 700 volts. The voltage is determined by a voltage plateau during calibration.

12. Battery. The battery voltage reading at the beginning of the measurement.

13. Alpha Probe Model No. The model number of the alpha scintillation probe.

14. Alpha Probe Serial No. The serial number of the alpha scintillation probe.

15. Alpha Probe Calibration Date. The date when the probe was last calibrated.

16. Date/Time of Eff Check. The date and time of the last efficiency check from the Daily Alpha Efficiency Check form.

17. Efficiency. Ratio of observed count rate to the known disintegration rate of the check source from the Daily Alpha Efficiency Check form.

18. Comments. Any additional information.

19. Item Surveyed (Specify). A description of the article swiped.

20. Instrument Reading (cpm). The count rate in counts per minute for the swipe.

21. Area Surveyed (cm^2). The swiped area measured in cm^2.

22. Adjusted Count Rate ($cpm/100\ cm^2$). If the area swiped was $100\ cm^2$, this is the meter cpm reading. If the swiped area was not $100\ cm^2$, the cpm reading must be adjusted to $cpm/100\ cm^2$ ~~in~~ order to apply the release limits from Appendix 5.5. The formula shown below is used.

$$\text{Adjusted cpm} = \frac{100\ cm^2}{\text{area swiped in } cm^2} \times \text{Instrument reading in cpm}$$

23. Contamination Level ($dpm/100\ cm^2$). The surface contamination level in units of dpm per $100\ cm^2$. Because the swiped area was adjusted to $100\ cm^2$, the removable contamination level is the instrument reading divided by the efficiency.

$$\text{Contamination level } (dpm/100\ cm^2) = \frac{\text{Adjusted cpm}}{\text{Efficiency}}$$

24. Within Release Limit? (Yes/No). The result of a comparison of the contamination level with the applicable release limit. The result may be abbreviated Y for yes if the measured contamination is less than the limit; N is used for no if above the limit.

APPENDIX 5.5

LIMITS FOR REMOVABLE SURFACE CONTAMINATION

NUCLIDE[a]	REMOVABLE[b][c]
U-nat, U-235,U-238, and associated decay products	1000 dpm α/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, and I-129	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, and I-133	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above	1000 dpm $\beta\gamma$/100 cm^2

[a] Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

[b] As used in this table, disintegrations per minute (dpm) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally. The entire surface should be wiped.

DRAFT PROCEDURE C-2

NEAR SURFACE AND SOIL SAMPLE SCREENING

FOR

LOW-ENERGY GAMMA RADIATION

USING THE FIDLER

STANDARD OPERATING PROCEDURE 6.7

NEAR SURFACE AND SOIL SAMPLE SCREENING FOR LOW-ENERGY GAMMA RADIATION USING THE FIDLER

1. PURPOSE

To describe the procedure in which a field instrument for the detection of low-energy radiation (FIDLER) is used to monitor surfaces and soil samples for the presence of low-energy gamma radiations that accompany some alpha emissions.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information on the scope of specific operations, related health and safety requirements, and the applicability of this procedure.

The FIDLER uses a thin, 5-inch-diameter sodium iodide (NaI) crystal to detect low-energy radiation. The NaI crystal is optically coupled to a quartz light pipe and installed in a standard 5-inch probe housing that has an entrance window of beryllium. The principal use of this detector is for photons with energies less than 75 kilo-electron volts (keV).

The FIDLER probe can be used to scan individual samples for low-energy photons that normally accompany alpha emissions. Uranium is principally an alpha emitter. However, the radiation from its daughter products includes low-energy photons, principally L-orbital x rays from thorium. In the case of U-238, for example, two low-energy photons from Th-234 can be detected by the FIDLER. During most investigations, the instrument will be adjusted for maximum response for the 63 keV photon from Th-234 or the 60 keV photon of Am-241 formed by the beta decay of Pu-241.

Data from these measurements are presented as gross counts in the 60 keV energy range. The combination of this information with gross alpha counts of the same sample conducted according to SOP 6.5, Screening Soil Samples for Alpha Emitters, can be used to determine the presence or absence of radionuclides.

Included in this procedure are instructions for 1) initial instrument setup (voltage plateau), 2) daily response standardization using a sealed check source, 3) determination of the instrument's response to terrestrial background radiation, and 4) use of the instrument to scan ground surface areas and samples.

3. PROCEDURE

3.1. Associated Procedures

Information that applies to most field activities is provided in SOPs 1.1-1.10. In addition to the FSP or WP, those SOPs provide guidance that may supplement the information in this procedure. They should be consulted as necessary to obtain specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
6.5	Screening Soil Samples for Alpha Emitters

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all equipment.

D. Obtain appropriate permission for property access.

E. Before the FIDLER can be used in the field, it is necessary to determine the correct operating voltage. This is accomplished by determining the plateau for background radiation and for radiation from a source of plutonium-238 in which the intensity is several times greater than background radiation levels. Determine the operating voltage once each week.

1. Inspect the FIDLER, the ratemeter/scaler, and interconnecting cable for obvious damage.

2. If no damage is observed, adjust the high voltage to 0 volts before connecting the FIDLER and the ratemeter/scaler.

3. Connect the FIDLER to the ratemeter/scaler in an area that has exhibited background radiation in previous measurements.

4. Turn the ratemeter/scaler selector switch to the high voltage setting and slowly adjust the high voltage to 900 volts (V).

5. Place the FIDLER in a position so that a series of 0.5-min counts can be made at various high-voltage settings.

6. Make three 0.5-min readings and record the voltage, count time, counts, and counts per minute in the columns on the Plateau Curve Record. When these three readings have been completed, adjust the high voltage upward 40 to 50 V. Repeat the three readings. Continue this procedure until three recordings have been made at a high-voltage setting of 1800 V.

7. Place the plutonium-238 source approximately 1 inch from the beryllium entrance window near the center of the probe and repeat the series of 0.5-min readings for high-voltage settings between 900 and 1800 V.

8. On the Plateau Curve Record, plot the FIDLER response as a function of high voltage. Set the ratemeter/scaler high voltage at the midpoint of th

plateau for field operation. Minor fluctuations in the high voltage caused by environmental conditions or battery drain will have little effect on the count rate. Record this ratemeter/scaler voltage on the Plateau Curve Record form.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check and information concerning the initial setup of the FIDLER in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

E. Record information concerning the initial setup of the FIDLER on the Plateau Curve Record form (Appendix 5.2). Instructions for completing the form are in Appendix 5.5 (Data Form Completion).

3.2.3. Field

A. Daily Source Check

1. Establish a fixed geometry between the detector and the source so that their relative position is a matter of record and reproducible from one work period to the next.

2. Make a 1-min counts with the plutonium-238 source in its check position. Record each count in the logbook.

C. Corrective Action

1. Check the ratemeter/scaler calibration due date.

2. Check to see that the ratemeter/scaler high voltage is set at the plateau midpoint.

3. Turn off the ratemeter/scaler and disconnect the cable to the FIDLER. Clean the cable and chassis connectors with ethyl alcohol and let dry.

4. Reconnect the cable, turn on the ratemeter/scaler, and check the voltage setting.

5. Check the source-to-detector distance and make any necessary corrections.

6. Repeat the daily source check procedure. If the FIDLER response is within the range of the average count rate ± 3 standard deviations, the unit may be used. If the average count rate is still outside the control boundary, turn off the instrument and use a substitute instrument. Repeated failures will require attention by the manufacturer. The FIDLER is temperature sensitive and will not function correctly at temperatures below 32°F.

D. Determination of Background

1. In order to provide a statistical basis to determine if samples or locations are contaminated, calculate the mean background and standard deviation.

   a. In a location designated as background (not in the contaminated area) or using five soil samples collected from a background area, perform a series of five 1-minute counts with the FIDLER probe in the same position as it will be for screening samples in locations (see Sections 3.3.1 and 3.3.2).

   b. Determine the mean and standard deviation of the five background counts.

$$\text{Mean} = X = \frac{x_1+x_2+x_3+x_4+x_5}{5}$$

where

x_1, x_2, x_3, x_4, x_5 = the background counts

standard deviation = SDX = $(X/5)^{1/2}$

2. The contamination criterion used for further samples is the mean background plus 3 standard deviations (X + 3SDX). Samples with 1-min counts greater than this criterion should be considered contaminated.

3. Record this number or criterion on the FIDLER Soil Sample Screening Log (Appendix 5.3) or the FIDLER Measurement Data form (Appendix 5.4), depending on the type of screening to be performed.

3.3. Operation

3.3.1 Screening Soil Samples

A. Record the soil sample screening data on the FIDLER Soil Sample Screening Log form (Appendix 5.3) following the instructions in Appendix 5.5, Data Form Completion.

B. Place the soil samples in the petri dishes (fill to the top).

C. The steps for screening samples are described below.

   1. Place the soil sample container (petri dish) in the counting shield.

   2. Place the FIDLER probe in a counting jig inside the lead shield so that it is positioned above the center of a sample container holder. Adjust the height so that the FIDLER is one inch above the sample container. Close the shield door.

   3. Turn the ratemeter/scaler selector switch to preset time and set the time for one min. Push the reset button to start and count.

4. Record the counts and the counting time on the FIDLER Soil Sample Screening Log form.

6. Remove the sample container, store it in sample archive, and repeat with additional samples.

3.3.2. Near-Surface Screening

A. The FIDLER Measurement Data form (Appendix 5.4) is completed as described in Appendix 5.5, Data Form Completion.

B. Determine that the FIDLER system has been checked and is ready for field measurements.

C. Refer to the FSP or WP for the areas to be scanned, the number of people required, time requirements, and special instructions.

D. Place the probe of the FIDLER directly on the ground and count for 0.5 or 1 min.

E. Drainage paths can only be scanned with a FIDLER if the area is free of standing or flowing water.

F. Record scan measurements as integral counts over the area to be scanned. Pulses from the FIDLER will be summed for 0.5 min or 1 min. Turn the main selector switch of the ratemeter/scaler to either 0.5 or 1 min (as specified in the FSP or WP).

G. After completing the scan, record the integrated count in its respective position on the FIDLER Measurement Data form (Appendix 5.4).

H. Compare the location count rate to the contamination criterion (average background and 3 standard deviations). If the count rate is greater, the location is marked Y for further study or characterization.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. If necessary, make sure all survey or sampling locations are properly staked and the location ID is readily visible on the location stake.

C. Ensure that all radiological sources and standards have been stored in a locked area.

3.4.2. Documentation

A. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

B. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the document control officer (with copies to the site manager and files) for eventual delivery to the client.

B. Inventory Equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

4. SOURCE

Becron. 1985. "Technical Manual, Model: Labtech Scaler/Ratemeter/Analyzer with 2-Channel Option." Bicron Corporation, Newbury, Ohio.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Plateau Curve Record

5.3. FIDLER Soil Sample Screening Log Form

5.4. FIDLER Measurement Data Form

5.5. Data Form Completion

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

________ FIDLER probe

________ Ratemeter/scaler with voltage indicator and optional headphones

________ Connector cable

________ Lead shield and counting jig (optional)

________ Plan view (site map) of the area to be surveyed that includes grid system coordinates

________ Calibrated measurement tape or chain

________ Pu-238 source or the equivalent

________ Hand-held calculator

________ FIDLER heat shield, if available

________ Linear graph paper for the performance control chart

________ Petri dishes for soil samples

APPENDIX 5.5

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

PLATEAU CURVE RECORD

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.
2. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).
3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.
4. Field Rep. The name of the field representative.
5. Acceptance Code. One-character code assigned by the site manager.
6. Ratemeter/Scaler Model No. The model number of the ratemeter/scaler.
7. Ratemeter/Scaler Serial No. The serial number of the ratemeter/scaler.
8. Ratemeter/Scaler Calibration Date. The date when the ratemeter/scaler was last calibrated.
9. Window. The window will be in the out position unless otherwise specified.
10. Threshold. The adjustment for the lower energy level of the discriminator shown on the calibration sticker.
11. Battery. The battery voltage reading at the beginning of the measurement.
12. Probe Model Number. The model number of the FIDLER probe.

13. Probe Serial Number. The serial number of the FIDLER probe.

14. Probe High Voltage. The final voltage setting that will be applied to the detector, as determined by the Plateau Curve procedure. For the FIDLER, the operating voltage should be about 1200V.

15. Check Source Serial No. The serial number of the radiation check source.

16. Check Source Isotope. The radioactive isotope contained in the check source given as element and mass number, like Am-241.

17. Check Source Activity. The activity of the radioactive check source in disintegrations per minute (dpm). An activity given in microcuries (μCi) can be converted to dpm using 2.22×10^6 dpm = 1 μCi.

18. Counts/Min. The count rate given in counts per minute (cpm).

19. High Voltage. The voltage applied to the detector during the collection of the associated counts.

APPENDIX 5.5, Continued

FIDLER SOIL SAMPLE SCREENING LOG

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

4. Field Rep. The name of the field representative.

5. Acceptance Code. One-character code assigned by the site manager.

6. Ratemeter/Scaler Model No. The model number of the ratemeter/scaler.

7. Ratemeter/Scaler Serial No. The serial number of the ratemeter/scaler.

8. Ratemeter/Scaler Calibration Date. The date when the ratemeter/scaler was last calibrated.

9. Window. The window will be in the out position unless otherwise specified.

10. Threshold. The adjustment for the lower energy level of the discriminator shown on the calibration sticker.

11. High Voltage. The voltage setting that is applied to the probe as determined by the Plateau Curve procedure.

12. Battery. The battery voltage reading at the beginning of the measurement.

13. NaI Probe Model No. The model number of the FIDLER probe.

14. NaI Probe Serial No. The serial number of the FIDLER probe.

15. NaI Probe Calibration Date. The date when the FIDLER probe was last calibrated.

16. Check Source Isotope. The radioactive isotope that the source contains, given as element and mass number, like Am-241.

17. Check Source Activity. The activity of the check source, measured in disintegrations per minute (dpm). An activity given in microcuries can be converted to dpm using 2.22×10^6 dpm = 1 μCi.

18. Check Source Serial No. The serial number of the check source.

19. Source Check Meter Reading. The results of a count on a check source. The check source data consists of three fields: total counts, counting time in minutes, and count rate in counts per minute (cpm).

20. Within ± 3 Standard Deviations (Y/N). This field describes the performance of the FIDLER.

21. Average Background + 3 Standard Deviations (cpm). This field gives the average background count rate + 3 standard deviations of the average count rate. It is used as a contamination criterion. Count rates greater than this are considered contaminated. Count time equals 1 min.

$$X = \text{Average or Mean Background} = \frac{x_1+x_2+x_3\ldots x_n}{N}$$

where

x_1, x_2, x_3 etc = individual background counts

N = the number of counts taken

SDX = standard deviation of the average background = $(X/N)^{1/2}$

22. Comments. Any additional information.

23. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

24. Coordinates (Ft). The location of the FIDLER measurement on the survey grid in units of feet. The two coordinate fields are in the format north and east.

25. Sample ID. The identifying code or number given to the sample.

26. Counts (=cpm). The number of counts registering on the FIDLER meter during the 1-min counting period.

27. Contaminated (Yes/No). If the counts per 1 min obtained are greater than the average background plus 3 standard deviations, the sample is considered contaminated. Enter Yes or Y if contaminated and No or N if not contaminated.

28. Estimated pCi/gram. If calibration factors are available for the specific site under investigation, the FIDLER cpm can be converted to a pCi/gram concentration. Enter N/A if these factors are not available.

FIDLER MEASUREMENT DATA FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

4. Field Rep. The name of the field representative.

5. Acceptance Code. One-character code assigned by the site manager.

6. Ratemeter/Scaler Model No. The model number of the ratemeter/scaler.

7. Ratemeter/Scaler Serial No. The serial number of the ratemeter/scaler.

8. Ratemeter/Scaler Calibration Date. The date when the ratemeter/scaler was last calibrated.

9. Window. The window will be in the out position unless otherwise specified.

10. Threshold. The adjustment for the lower energy level of the discriminator shown on the calibration sticker.

11. Voltage. The voltage setting that is applied to the probe, as determined by the Plateau Curve procedure.

12. Battery. The battery voltage reading at the beginning of the measurement.

13. NaI Probe Model No. The model number of the FIDLER probe.

14. NaI Probe Serial No. The serial number of the FIDLER probe.

15. NaI Probe Calibration Date. The date when the FIDLER probe was last calibrated.

16. Check Source Isotope. The radioactive isotope that the source contains, given as element and mass number, like Am-241.

17. Check Source Activity. The activity of the check source, measured in disintegrations per minute (dpm). An activity given in microcuries (μCi) can be converted to dpm using 2.22×10^6 dpm = 1 μCi.

18. Check Source Serial No. The serial number of the check source.

19. Source Check Meter Reading. The results of a count on a check source. Check source data consists of three fields: total counts, count time in minutes, and count rate in cpm.

20. Within ± 3 Standard Deviations. This field describes the performance of the FIDLER, from the control chart in Section 3.2.3.B, Field Preparation. Enter Y (yes) or N (no).

21. Average Background + 3 Standard Deviations. This field gives the average background count rate (cpm) + 3 standard deviations of the average. It is used as a contamination criterion; count rates greater than this number indicate contaminated areas.

$$X = \text{Average or Mean Background} = \frac{x_1+x_2+x_3 \ldots x_n}{N}$$

where

x_1, x_2, x_3, etc. = individual background counts

N = the number of counts taken

SDX = standard deviation of the average background = $(X/N)^{1/2}$

22. Comments. Any additional information.

23. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

24. Integrated Count (cpm).

25. Contaminated. If the count rate recorded is greater than the average background plus 3 standard deviations, the location is considered contaminated (Y). If it is less, it is not considered contaminated (N).

DRAFT PROCEDURE C-3

BETA-GAMMA RADIATION MEASUREMENTS
USING A
GEIGER-MUELLER DETECTOR

STANDARD OPERATING PROCEDURE 6.11

BETA-GAMMA RADIATION MEASUREMENTS USING A GEIGER-MUELLER DETECTOR

1. PURPOSE

To describe the methodology for measuring beta-gamma radiation levels.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information on the scope of specific operations, related health and safety requirements, and the applicability of this procedure to the activities.

Potential hazards from radionuclides that are beta-gamma emitters (like strontium-89) arise from ingestion or inhalation and external radiation that penetrates critical body organs. Protection requires the measurement and control of internal and external pathways.

Beta and gamma radiations are considered together because many radioactive materials emit both. The techniques for measuring the two are similar. A calibration source should be selected that most closely represents the energies of the radiation field to be measured.

For survey purposes, beta-gamma measurements can be used to verify the presence of anomalous radiation levels. Because of the attenuation of the beta particles and photons by the soil, these measurements cannot be used to make a direct correlation to radionuclide concentrations in soil without a portable gamma spectrometer for field identification of the radionuclides.

For general beta-gamma radiation monitoring, the ionization chamber and the Geiger-Mueller (GM) counter are the primary instruments. Only the technique using the GM counter will be described here.

Portable GM counters have battery-operated power supplies and amplifiers. The sensitive element is a small Geiger tube contained in a probe. The probe is attached to a ratemeter/scaler that has several different scales, a time-response switch, and an audible output.

Two GM probe configurations are described in this procedure: a pancake probe and an energy-compensated tube. The pancake probe consists of a flat, thin-windowed GM tube in a shielded housing. It measures radiation coming primarily from in front of the thin window and is used for measuring beta-gamma contamination on surfaces. The energy-compensated probe is typically a thick-walled GM tube measuring 4 to 6 inches long that is covered with a material of sufficient thickness to allow consistent measurement over a broad energy range. The GM tube measures radiation from any direction and absorbed dose rates from beta-gamma radiation fields of energies greater than about 100 kilo-electron volts (keV).

2.1. Limitations

GM counters have several characteristics that can lead to erroneous results unless the user is aware of them.

A. At high radiation levels, the counter will not recover from a count soon enough to measure the next entering particle. This causes a decreased response at higher radiation levels; at extremely high levels, the response may no longer increase with increased radiation. In certain cases, the response may decrease or go to zero at very high levels.

B. At extreme temperatures, the instrument may respond erratically or not at all. Under these conditions, a check source is needed to ensure reliable behavior.

C. The GM tube is delicate and sensitive to damage if dropped or exposed to significant changes in air pressure. If a rattling sound is heard when the user blows air across the probe face, it is likely that the tube has broken. To avoid a common means of tube breakage, do not ship the probe in an unpressurized airplane.

3. PROCEDURE

3.1. Associated Procedures

Information that applies to most field activities is provided in SOPs 1.1-1.10. In addition to the FSP or WP, those SOPs provide guidance that may supplement the information in this procedure. They should be consulted as necessary to obtain specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures direc[illegible] associated with this SOP are listed below.

SOP No.	Sop Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination

3.2. Preparation

3.2.1. <u>Office</u>

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the current calibration of the probe and the ratemeter/scaler.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check and calibration in the logbook.
Daily Efficiency Checks will be performed 2 times daily on the enclosed form. MC 1/94

C. Obtain a sufficient number of the appropriate data collection forms (see INDEX TO SOPs).

D. Consult the data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Take five, 1-min background counts to ensure that the probe is not contaminated and to determine contamination criteria. If the count rate is greater than normal, check for surface contamination and be sure that the high-voltage setting is as marked on the probe. Calculate the mean background, the standard deviation of the mean, and three times the standard deviation as shown below.

$$X = (x_1 + x_2 + x_{3...}+x_n) / N$$

where

X = the mean

N = number of samples

$x_1+x_2+x_{3...}x_n$ = summation of count results for all background counts measured

SDX = standard deviation of the mean = $(X/N)^{1/2}$

3SDX = $3(X/N)^{1/2}$ = contamination criterion

B. Take a 1-min count using a check source (like Tc-99) to check instrument response. The efficiency of the Ludlum 44-9 is typically about 15%.

Efficiency = net counts per minute/source disintegrations per minute

3.3. Operation

3.3.1. Obtaining Measurements

A. Record beta-gamma measurements with the GM detector on the Beta-Gamma Measurements form (Appendix 5.2). Complete the form according to Appendix 5.3, Data Form Completion.

B. Place the GM probe at a small distance (one-half inch) from the location to be monitored.

NOTE: The thin window of the probe is easily punctured. Care should be taken to protect the surface from sharp objects.

C. Take a count of predetermined duration (0.5 min to 2 min) and record the count rate.

D. If using an energy-compensated GM, multiply the count rate by the calibration factor and determine the beta-gamma dose rate in millirads/hour (mrad/hr).

E. Compare the counts to the contamination criteria. The FSP or WP may require further characterization of samples or locations exceeding these criteria. Samples or locations with counts greater than 3SDX are considered contaminated.

3.4. Postoperation

3.4.1. Field

A. Turn all switches to the off position.

B. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

C. If necessary, make sure all survey or sampling locations are properly staked and the location ID is readily visible on the location stake.

3.4.2. Documentation

A. Record any uncompleted work (like additional monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the document control officer (with copies to the site manager and files) for eventual delivery to the client.

B. Ensure that all radiological sources and standards have been stored in a locked area.

C. Inventory equipment and supplies. Repair or replace all broken or damaged items. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunctions or damage.

4. SOURCE

Healy, J. W. 1970. "Los Alamos Handbook of Radiation Monitoring." Los Alamos Scientific Laboratory report LA-4400. Los Alamos, New Mexico.

5. APPENDIXES

5.1 Equipment and Supplies Checklist

5.2 Beta-Gamma Measurements Form

5.3 Data Form Completion

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

________ GM pancake probe (Ludlum 44-9 or the equivalent)

________ Ratemeter/scaler (Ludlum 2220 or the equivalent)

________ Energy-compensated GM (Ludlum 44-38 or the equivalent)

________ Cable

________ Beta source (TC-99 or Sr-90)

APPENDIX 5.3

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

BETA-GAMMA MEASUREMENTS FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date that information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

4. Field Rep. The name of the field representative.

5. Acceptance Code. One-character code assigned by the site manager.

6. Ratemeter/Scaler Model No. The model number of the ratemeter/scaler.

7. Ratemeter/Scaler Serial No. The serial number of the ratemeter/scaler.

8. Ratemeter/Scaler Calibration Date. The date when the ratemeter/scaler was last calibrated.

9. Voltage. The voltage that is applied to the detector. For a pancake Geiger-Mueller (GM), this is usually about 900 volts.

10. Battery. The battery voltage reading at the beginning of the measurement.

11. GM Probe Model No. The model number of the GM probe.

12. GM Probe Serial No. The serial number of the GM probe.

13. GM Probe Calibration Date. The date when the GM probe was last calibrated.

14. Average Background cpm + 3 Standard Deviations. This field is used to establish contamination criteria for use in sample selection for analyses or general screening.

    Average background = $X = (x_1+x_2+x_3+...X_n) / N$

    where

    $x_1, x_2, x_3...x_n$ = a summation of all the background counts obtained

    N = the total number of background counts taken

    3 standard deviations = $3SDX = 3(X/N)^{1/2}$

15. Source Check Date/Time. The date and time the system was last source checked. mcd 19 mar 92

16. The efficiency of the meter ~~EH~~ Eff. = cpm/dpm.

17. Window Open (O) or Window Closed (C). When using an energy-compensated GM, the window can be open or closed as specified in the site Health and Safety Plan. Enter N/A if using a pancake GM.

18. Calibration Factor. The calibration factor in millirads per hour (mrad/hr)/counts per minute (cpm) used to convert cpm to mrad/hr when using an energy-compensated GM. Enter N/A if using a pancake GM.

19. Comments. Any additional information.

20. Location ID. ~~Four~~ Six-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken. mcd 19mar92

21. Coordinates (Ft). The coordinates of the measurement location in feet. The format is north and east. These will be filled in at a later date when the su locate the final sampling locations. mcd 19Mar92

2~~2. Sample ID or Item Description. The sample identification numbe~~r or ~~description of the item being counted. Enter N/A if not applica~~ble. Not on New mcd 19 mar 92

23. Counts. The counts obtained over the counting period. Enter N/A if using a ratemeter.

24. Count Time. The time in minutes over which the counts were collected. Enter N/A if using a ratemeter.

25. CPM. The counts per minute obtained by dividing the total counts by the counting time or by recording the ratemeter cpm reading.

26. DPM. The disintigrations per minute obtained by dividing the cpm by the efficiency.

27. mrad/hr. The dose rate obtained using a calibration factor applied to an energy-compensated GM.

28. Above Criteria (Yes/No). If the counts obtained are greater than the average background + 3 standard deviations, the item or location is considered contaminated (yes). If the counts are below this criterion, the item or location is not considered contaminated (no).

The Beta-Gamma Efficiency Check Form and The Beta-Gamma-Background Evaluation form are attached. They have the same basic information at the top of the farm as the Beta-Gamma Measurements Form. Differences are explained on the Forms.

BETA-GAMMA MEASUREMENTS

PAGE 1 OF ______

FACILITY CODE ______________________ LOG DATE ______________________

LOGGER CODE ______________________ FIELD REP ______________________

RATEMETER/SCALER:

ACCEPTANCE CODE ______________________

MODEL NO ______________ SERIAL NO __________ CALIBRATION DATE __________

VOLTAGE ______________ BATTERY __________

GM PROBE:

MODEL NO ______________ SERIAL NO __________ CALIBRATION DATE __________

AVERAGE BACKGROUND CPM __________ + 3 STANDARD DEVIATIONS = $3(\frac{\bar{X}}{N})^{\frac{1}{2}}$ = __________

SOURCE CHECK DATE/TIME ______________________ EFFICIENCY __________ CPM/DPM

CHECK SOURCE ISOTOPE __________ SERIAL NUMBER __________ ACTIVITY __________ DPM

WINDOW OPEN (O) OR WINDOW CLOSED (C) ______________

CALIBRATION FACTOR ______________ (mrad/hr)/CPM

COMMENTS ____

LOC ID	COORDINATES (FT)		COUNTS	COUNT TIME	CPM	DPM	mrad/hr	ABOVE CRITERIA (YES/NO)
	NORTH	EAST						

ACCEPTANCE CODES: A—ACCEPTABLE R—RECONNAISSANCE U—UNACCEPTABLE N—NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
BGM-121 (3/88)

FORM COMPLETED BY/DATE

TECHNICAL REVIEWER/DATE

BETA–GAMMA MEASUREMENTS

PAGE ____ OF ____

FACILITY CODE ______________________ LOG DATE ______________________

LOGGER CODE ______________________ FIELD REP ______________________

LOC ID	COORDINATES (FT)		COUNTS	COUNT TIME	CPM	DPM	mrad/hr	ABOVE CRITERIA (YES/NO)
	NORTH	EAST						

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS

BGM-121 (1/88)

BETA – GAMMA – BACKGROUND EVALUATION

FACILITY CODE ______ **LOG DATE** ______

LOGGER CODE ______ **FIELD REP** ______

RATEMETER/SCALER: **ACCEPTANCE CODE** ______

MODEL NO ______ **SERIAL NO** ______ **CALIBRATION DATE** ______

WINDOW OUT THRESHOLD ______ HIGH VOLTAGE ______ BATTERY ______

↑ NA for Pancake G-M meters mcd 19Mar92

PROBE:

MODEL NO ______ **SERIAL NO** ______ **CALIBRATION DATE** ______

CHECK SOURCE: ✓ Info. for this section will be taken from the daily Eff. Check form mcd 19Mar

ISOTOPE ______ ACTIVITY ______ DPM SERIAL NO ______

METER READING ______ COUNTS/ ______ MIN = ______ CPM

EFFICIENCY ______ CPM/ ______ DPM = ______ CPM/DPM

COMMENTS ______

LOCATION ID OR DESCRIPTION	COUNT TIME	BACKGROUND CPM	BACKGROUND DPM
Description of			
where Background			
counts were taken			

MEAN = $\bar{X}$ = ______ ← See Sec. 3.2.3.A for info on how to fill out these.

STANDARD DEVIATION = SD$\bar{X}$ = $(\frac{\bar{X}}{N})^{1/2}$ = ______

mcd 19Mar92

ACCEPTANCE CODES: A—ACCEPTABLE R—RECONNAISSANCE U—UNACCEPTABLE N—NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
BGEE-108 (2/88)

______ FORM COMPLETED BY/DATE

______ TECHNICAL REVIEWER/DATE

DAILY BETA – GAMMA EFFICIENCY CHECK

FACILITY CODE __________ FIELD REP __________

LOGGER CODE __________ ACCEPTANCE CODE __________

RATEMETER/SCALER:

MODEL NO __________ SERIAL NO __________ CALIBRATION DATE __________

WINDOW OUT THRESHOLD __________ HIGH VOLTAGE __________ BATTERY __________

[illegible] PROBE: NA for Pancake G-M meters mcl 19 Mar 92

MODEL NO __________ SERIAL NO __________ CALIBRATION DATE __________

SOURCE: This info comes from the source used in the daily Efficiency check.

SERIAL NO __________ ISOTOPE __________ ACTIVITY __________ DPM

LOG DATE	TIME (HH:MM)	COUNTING TIME (MIN)	BACKGROUND CPM	GROSS COUNTS	GROSS CPM	NET CPM	EFFICIENCY (NET CPM/DPM)
Date &	Time	NA for		NA for		Gross	See Sec.
Efficiency	was	Ratemeters		Ratemeters		CPM	3.2.3.B.
done.						minus	
						Background	
						CPM	

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TMS
DAE-103 (3/[illegible])

____
FORM COMPLETED BY/DATE

____
TECHNICAL REVIEWER/DATE

DRAFT PROCEDURE C-4

SCREENING SOIL SAMPLES
FOR
ALPHA EMITTERS

STANDARD OPERATING PROCEDURE 6.5

SCREENING SOIL FOR ALPHA EMITTERS

1. PURPOSE

To provide a method of screening for alpha-emitting radionuclides in soil samples.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information about the scope of specific operations and the applicability of this procedure to the activities.

No regulatory *de minimis* level has been established to designate material that contains a negligible concentration of radioactive material. This procedure compares the measurement result to background and establishes the average background value plus 3 standard deviations of the background as the criterion above which samples are considered contaminated.

The instrument used is a portable ZnS alpha detector having an efficiency of at least 15%. The minimum detectable gross-alpha activity for this method is about 50 picoCuries per gram (pCi/g).

3. PROCEDURE

3.1. Associated Procedures

Information that applies to most field activities is provided in SOPs 1.1-1.10. In addition to the FSP or WP, those SOPs provide guidance that may supplement the information in this procedure. They should be consulted as necessary to obtain specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination

3.2. Preparation

3.2.1. <u>Office</u>

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. calibration of the alpha scintillation probe and scaler.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record the results of the calibration in the logbook. A file with all ca records will be keep with all other data from the field effort. mc

C. Obtain a sufficient number of the appropriate data collection forms (see I

TO SOPs).

D. Consult the data administrator for a current list of information manage codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Turn the instrument power switch to on and check the batteries for adequat power.

B. Perform a source check of the instrument using the procedures outlined below.

1. Count the check source for 1 min to obtain the gross counts per minute (cpm).

2. Perform a 10-min background count. Divide the resulting counts by 10 to obtain background cpm. This count rate should be low, about 1.0 cpm for the Ludlum 43-1 probe. Any significant increase in this count rate may mean that the instrument or work area needs to be decontaminated.

We will be using a
minute background
unt because the
aler is only capable
a 1 minute count.
19Mar92
PWO

3. Determine the efficiency as described in Appendix 5.4, Data Fo[illegible] Completion. The efficiency for the Ludlum 43-1 probe should be approximately 17%. A significant decrease or increase in the efficiency can suggest a malfunction and should be investigated.

$$\text{Efficiency} = \frac{\text{counts per minute (cpm)}}{\text{disintegrations per minute (dpm)}}$$

3.3. Operation

3.3.1 Background

To provide a statistical basis for evaluating alpha-count data as a function of background alpha-count data, 5 background counts will be taken. The average and standard deviation of the background alpha count are then determined. Samples subsequently counted with a 1-min count greater than the average background plus 3 standard deviations of the background will be considered contaminated. This information is recorded on the background evaluation form at the end of this SOP. MCJ 19Mar92

3.3.2. Alpha Counting of Soil

A. Turn on the instrument and perform a source check as described in Section 3.2.3. A source check should be performed daily. Efficiency check will be perfor twice daily and recorded on the daily efficiecy check form attached at the end of this SOP.

B. Place the probe on the soil at the location specified in the FSP or WP. Ensure that sharp debris does not puncture the Mylar covering the probe face.

C. Count the surface soil for 1 min. Record the accumulated counts on the Gross Alpha Screening Field Log form (Appendix 5.3) as described in Appendix 5.4.

D. Compare the sample counts with the average background count plus 3 standard deviations of the background count. If the former count data are greater than the latter, the sample is considered contaminated (Y). If the counts are less, the sample is not considered contaminated (N).

3.4. Postoperation

3.4.1. Field

A. Turn the power switch on the ratemeter/scaler to the off position.

B. Place the protective cover on the alpha scintillator probe.

C. Turn the power switch on the heat lamp to the off position.

D. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

E. If necessary, make sure all survey or sampling locations are properly staked and the location ID number is readily visible on the location stake.

3.4.2. Documentation

A. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

B. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the document control officer (with copies to the site manager and files) for eventual delivery to the client.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

4. SOURCES

Ludlum. 1986. Model 43-1 "Instruction Manual, Alpha Scintillator." Ludlum Measurements, Inc., January 1986. Sweetwater, Texas.

Ludlum. 1982. "Instruction Manual, Model 2220 Portable Scaler." Ludlum Measurements, Inc., April 1982. Sweetwater, Texas.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Gross Alpha Screening Field Log--Background Evaluation Form

5.3. Gross Alpha Screening Field Log Form

5.4. Data Form Completion

APPENDIX 5.1

EQUIPMENT CHECKLIST

________ Ludlum model 43-1 alpha scintillation probe or equivalent

________ Ludlum model 2220 portable scaler or equivalent

________ Mylar film having thickness of 100 $\mu g/cm^2$

________ Alpha check source

________ Hand-held calculator

APPENDIX 5.4

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

GROSS ALPHA SCREENING FIELD LOG--BACKGROUND EVALUATION FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

4. Field Rep. The name of the field representative.

5. Acceptance Code. One-character code assigned by the site manager.

6. Ratemeter/Scaler Model No. The model number of the ratemeter/scaler.

7. Ratemeter/Scaler Serial No. The serial number of the ratemeter/scaler.

8. Ratemeter/Scaler Calibration Date. The date when the ratemeter/scaler was last calibrated.

9. Window. The window will be in the out position unless otherwise specified.

10. Threshold. The adjustment for the lower energy level of the discriminator given on the calibration sticker.

11. High Voltage. The voltage that is applied to the detector given on the calibration sticker.

12. Battery. The battery voltage reading at the beginning of the measurement.

13. Probe Model No. The model number of the alpha scintillation probe.

14. Probe Serial No. The serial number of the alpha scintillation probe.

15. Probe Calibration Date. The date when the alpha scintillation probe was last calibrated.

16. Check Source Isotope. The radioactive isotope contained in the check sour[illegible] given as element and mass number, like Th-230.

17. Check Source Activity. The activity of the radioactive check source in disintegrations per minute (dpm). An activity given in microcuries (μCi) can be converted to dpm using 2.22×10^6 dpm = 1 (μCi).

18. Check Source Serial No. The serial number of the radiation check source.

19. Check Source Meter Reading. The results of a count on the check source. Check Source data consists of three fields: total counts, count time in minutes, and count rate in counts per minute (cpm).

20. Check Efficiency. The ratio of the observed count rate (cpm) to the true disintegration rate (dpm) of the check source.

    Efficiency = cpm/dpm

21. Comments. Any additional information.

22. Count time. Length of background count time in minutes.

23. Background CPM. The counts per minute of the background count.

24. Background DPM. The disintigrations per minute for the background count

25. Mean (M). The average count obtained for the background counts. The mean is calculated as shown below.

$$X = \frac{x_1 + x_2 + x_3 + x_4 + x_5}{N}$$

where,

X = mean

N = number of background measurements

$x_1 + x_2 + x_3 + x_4 + x_5$ = summation of all background counts

27. Standard Deviation (SDX). The standard deviation of the mean is calculated as shown below.

$$SDX = (X/N)^{1/2} = (X/5)^{1/2}$$

where,

N = the number of samples = 5

X = the mean

GROSS-ALPHA SCREENING FIELD LOG FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Logger Code. Three-character or four-character code assigned by the site manager.

3. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

4. Field Rep. The name of the field representative.

5. Acceptance Code. One-character code assigned by the site manager.

6. Ratemeter/Scaler Model No. The model number of the ratemeter/scaler.

7. Ratemeter/Scaler Serial No. The serial number of the ratemeter/scaler.

8. Ratemeter/Scaler Calibration Date. The date when the ratemeter/scaler was last calibrated.

9. Window. The window will be in the out position unless otherwise specified.

10. Threshold. The adjustment for the lower energy level of the discriminator given on the calibration sticker.

11. High Voltage. The voltage that is applied to the detector given on the calibration sticker.

12. Battery. The battery voltage reading at the beginning of the measurement.

13. Probe Model No. The model number of the alpha scintillation probe.

14. Probe Serial No. The serial number of the alpha scintillation probe.

15. Probe Calibration Date. The date when the alpha scintillation probe was calibrated.

16. Check Source Isotope. The radioactive isotope contained in the check sour given as element and mass number, like Th-230.

17. Check Source Activity. The activity of the radioactive check source in disintegrations per minute (dpm). An activity given in microcuries (μCi) can be converted to dpm using 2.22×10^6 dpm = 1 μCi.

18. Check Source Serial No. The serial number of the radiation check source.

19. Source Check Meter Reading. The results of a count on the check source. Check source data consists of three fields: total counts, count time in minutes, and count rate in counts per minute (cpm).

20. Source Check Efficiency. The ratio of the observed count rate (cpm) to the true disintegration rate (dpm) of the check source.

Efficiency = cpm/dpm

21. Average Background Count plus 3 Standard Deviations. This quantity has been derived from counts on background samples. See entries 26 and 27 of this appendix (Gross Alpha Screening Field Log--Background Evaluation form) for these calculations.

22. Comments. Any additional information.

Six mcs 19Mar92

23. Location ID. ~~Four~~ character code assigned sequentially to each borehole, t pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

24. Coordinates (Ft). The location where the sample was collected relative to the survey grid in feet. There are two fields in the coordinate description, north and east. This info. will be filled in at a later date once the Surveyors can obtain the final coordinates of the sample locations. mcs 19Mar92

25. Sample CPM.

26. Sample DPM. DPM = CPM ÷ Eff.

27. Above Criteria? A flag column to mark samples for further consideration. A yes (Y) is entered if the sample count exceeds the criteria; a no (N) is entered if the sample count does not exceed the criteria.

The Daily Alpha Efficiency Check Form will be used to record ~~the~~ all efficiency check info. mcs 19m

GROSS ALPHA SCREENING FIELD LOG — BACKGROUND EVALUATION

FACILITY CODE ____________ LOG DATE ____________

LOGGER CODE ____________ FIELD REP ____________

ACCEPTANCE CODE ____________

RATEMETER/SCALER:

MODEL NO ____________ SERIAL NO ____________ CALIBRATION DATE ____________

WINDOW OUT THRESHOLD ____________ HIGH VOLTAGE ____________ BATTERY ____________

PROBE:

MODEL NO ____________ SERIAL NO ____________ CALIBRATION DATE ____________

CHECK SOURCE:

ISOTOPE ____________ ACTIVITY ____________ DPM SERIAL NO ____________

METER READING ____________ COUNTS/ ____________ MIN = ____________ CPM

EFFICIENCY ____________ CPM/ ____________ DPM = ____________ CPM/DPM

COMMENTS ____________

LOCATION ID OR DESCRIPTION	COUNT TIME	BACKGROUND CPM	BACKGROUND DPM

MEAN = $\overline{X}$ = ____________

STANDARD DEVIATION = SD$\overline{X}$ = $\left(\frac{\overline{X}}{N}\right)^{1/2}$ = ____________

ACCEPTANCE CODES: A—ACCEPTABLE R—RECONNAISSANCE U—UNACCEPTABLE N—NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TMS

GAS—108 (2/88)

____________ FORM COMPLETED BY/DATE

____________ TECHNICAL REVIEWER/DATE

GROSS ALPHA SCREENING FIELD LOG

PAGE 1 OF ______

FACILITY CODE ______ LOGGER CODE ______

LOG DATE ______ FIELD REP ______

ACCEPTANCE CODE ______

RATEMETER/SCALER:

MODEL NO ______ SERIAL NO ______ CALIBRATION DATE ______

WINDOW OUT THRESHOLD ______ HIGH VOLTAGE ______ BATTERY ______

PROBE:

MODEL NO ______ SERIAL NO ______ CALIBRATION DATE ______

CHECK SOURCE:

ISOTOPE ______ ACTIVITY ______ DPM SERIAL NO ______

SOURCE CHECK METER READING ______ COUNTS/ ______ MIN = ______ CPM

EFFICIENCY ______ CPM/ ______ DPM = ______ CPM/DPM

AVERAGE BACKGROUND COUNT $(\bar{X})+3$ STANDARD DEVIATIONS $3(SD\bar{X})=$ ______

COMMENTS ______

LOCATION ID	COORDINATES (FT)		SAMPLE CPM	SAMPLE DPM	ABOVE CRITERIA YES(Y) OR NO(N)
	NORTH	EAST			

ACCEPTANCE CODES: A—ACCEPTABLE R—RECONNAISSANCE U—UNACCEPTABLE N—NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TMS
GAB—106 (2/88)

FORM COMPLETED BY/DATE

TECHNICAL REVIEWER/DATE

GROSS ALPHA SCREENING FIELD LOG

PAGE ____ OF ____

FACILITY CODE ____________________ LOGGER CODE ____________________

LOG DATE ____________________ FIELD REP ____________________

LOCATION ID	COORDINATES (FT)		SAMPLE CPM	SAMPLE DPM	ABOVE CRITERIA? YES(Y) OR NO(N)
	NORTH	EAST			

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
GAS-106 (3/88)

DAILY ALPHA EFFICIENCY CHECK

FACILITY CODE ______________________ FIELD REP ______________________

LOGGER CODE ______________________ ACCEPTANCE CODE ______________________

RATEMETER/SCALER:

MODEL NO ____________ SERIAL NO ____________ CALIBRATION DATE ____________

WINDOW OUT THRESHOLD ____________ HIGH VOLTAGE ____________ BATTERY ____________

ALPHA SCINTILLATION PROBE:

MODEL NO ____________ SERIAL NO ____________ CALIBRATION DATE ____________

SOURCE:

SERIAL NO ____________ ISOTOPE ____________ ACTIVITY ____________ DPM

LOG DATE	TIME (HH:MM)	COUNTING TIME (MIN)	BACKGROUND CPM	GROSS COUNTS	GROSS CPM	NET CPM	EFFICIENCY (NET CPM/DPM)
Date	& Time					Gross	See Sec.
Efficiency						CPM	3.2.3.B
check	was					minus	
performed						Background	
						CPM	

ACCEPTANCE CODES: A—ACCEPTABLE R—RECONNAISSANCE U—UNACCEPTABLE N—NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
DAE-103 (3/88)

______________________ FORM COMPLETED BY/DATE

______________________ TECHNICAL REVIEWER/DATE

DRAFT PROCEDURE C-5

MONITORING OF ORGANIC VAPORS
WITH A
PHOTO IONIZATION DETECTOR

STANDARD OPERATING PROCEDURE 6.2

HEALTH AND SAFETY MONITORING OF ORGANIC VAPORS WITH A PHOTOIONIZATION DETECTOR

1. PURPOSE

To describe the equipment and proper method for environmental monitoring of tc gases and vapors using a portable photoionization detector (PID).

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information on the scope the given operation and the applicability of this procedure to the work activities.

The PID is useful as a general survey instrument at hazardous waste sites. A PID capable of detecting and measuring real-time concentrations of many organic a inorganic vapors in the air. A PID is similar to a flame ionization detector (FID) application. The PID has somewhat broader capabilities because it can detect cert inorganic vapors. Conversely, the PID is unable to respond to certain low molecu weight hydrocarbons (like methane and ethane) that are readily detected by F instruments. Appendix 5.1 describes the application comparisons between an FID orga vapor analyzer and a PID.

A PID will respond to most vapors that have an ionization potential less than or equal that supplied by the ionizing source in the detector, which is an ultraviolet (UV) lar Several probes are available for the PID, each having a different source and a differe ionization potential. For this reason, the selection of the appropriate probe is essential obtaining useful field results. Though it can be calibrated to a particular compound, t instrument cannot distinguish between detectable compounds in a mixture of gas Therefore, it indicates an integrated response to the mixture.

2.1. PID Instrument Limitations

A. The PID is a nonspecific total vapor detector. It cannot be used to identi unknown substances; it can only quantify them.

B. The PID must be calibrated to a specific compound.

C. The PID does not respond to certain low molecular weight hydrocarbons li methane and ethane.

D. Certain toxic gases and vapors like carbon tetrachloride and hydrogen cyani have high ionization potentials and cannot be detected with a PID.

E. Certain models of PID instruments are not intrinsically safe. Refer to t manufacturer's operating manual for use in potentially flammable or combustit atmospheres. A PID should be used in conjunction with a combustible g indicator (see SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels

F. Electrical power lines or power transformers close to the PID instrument may cause measurement errors. Under this circumstance, refer to the operating manual for proper procedures.

G. High winds and high humidity will affect measurement readings. Certain models of PID instruments become unusable under foggy conditions. An indication of this is the needle dropping below 0.

H. The lamp window must be periodically cleaned to ensure ionization of the air contaminants.

I. One PID instrument, the HNu, measures concentrations from about 1 to 2000 ppm, although the response is not linear over this entire range. For example, the response to benzene is linear from about 0 to 600 ppm. This means the HNu reads a true concentration of benzene only between 0 and 600. Greater concentrations are read at a lower level than the true value. Consult the manufacturer's operating manual to determine the instrument's response to various chemicals.

2.2. Regulatory Limitations

A. Transport of calibration gas cylinders by passenger and cargo aircraft follow the U.S. Code of Federal Regulations, 49 CFR Parts 100-177. Benzene is a typical calibration gas included with a PID. Benzene is classified as a nonflammable gas, UN 1556, and the proper shipping name is compressed gas. It must be shipped in cargo aircraft only.

3. PROCEDURE

3.1. Associated Procedures

Information that applies to most field activities is provided in SOPs 1.1-1.10. In addition to the FSP or WP, those SOPs provide guidance that may supplement the information in this procedure. They should be consulted as necessary to obtain specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
6.1	Health and Safety Monitoring of Combustible Gas Levels

3.2. Preparation

3.2.1 Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.2. Perform procedures described below.

1. Start-Up Procedure

   a. Before attaching the probe, check the function switch on the con panel to ensure that it is in the off position. Attach the probe plugging it into the interface on the top of the readout module. Use in aligning the prongs in the probe cord with the plug interface. Do use excessive force.

   b. Turn the function switch to the battery check position. The needle the meter should be within or above the green battery arc on the scal not, recharge the battery. If the red indicator light comes on, the bat needs recharging.

   c. Turn the function switch to any range setting. Look into the end of probe to see if the lamp is on. If it is on, it will emit a purple glow. not stare into the probe any longer than 3 sec. Long-term exposur UV light will damage the eyes. Also, listen for the hum of the motor.

   d. To zero the instrument, turn the function switch to the standby posi and rotate the zero adjustment until the meter reads zero. A calibra gas is not needed because this is an electronic zero adjustment. If span adjustment setting is changed after the zero is set, the zero sho be rechecked and adjusted (if necessary). Wait 15 to 20 sec to ensure the zero reading is stable. If necessary, readjust the zero.

2. Operational Check

   a. Follow the start-up procedure.

   b. With the instrument set on the 0 to 20 range, hold a solvent-based mar pen near the probe tip. If the meter deflects upscale, the instrumen working.

3. Calibration Procedure

   a. Follow the start-up procedure and the operational check.

   b. Set the function switch to the range setting for the concentration of calibration gas.

   c. Remove the detector from the outer casing by loosening the screw on bottom of the casing.

   d. Attach a regulator to a disposable cylinder of calibration gas. Conn the regulator to the probe of the PID with a piece of clean tygon tubi Open the valve on the regulator.

e. After 15 sec, adjust the internal calibration screw until the meter reading equals the concentration of the calibration gas used. Consult the operating manual for the location of this screw.

f. If the PID does not start up, check out or calibrate properly and notify the equipment manager immediately. Under no circumstances should work requiring monitoring with a PID be performed without a properly functioning instrument.

g. Replace the detector in the outer casing.

h. Contact the carrier that will transport equipment and hazardous materials to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of management codes, location IDs, and sample numbers used in the completion of data forms.

E. Record the calibration data on the Photoionization Detector Field Data form (Appendix 5.3). See Appendix 5.4 (Data Form Completion) for instructions.

3.2.3. Field

A. Follow the start-up procedure, operational check, and calibration check described in Section 3.2.1.D.

B. Set the function switch to the appropriate range. If the concentration of gases or vapors is unknown, set the function switch to the 0 to 20 ppm range; adjust the range if necessary.

C. With the exception of the probe's inlet and exhaust, wrap the PID in clear plastic to prevent it from becoming contaminated and to prevent water from getting inside the instrument in the event of precipitation.

3.3. Operation

3.3.1 Measuring organic vapor levels using the PID

A. As with any field instrument, accurate results depend on the operator's knowledge of the operator's manual. Follow the instructions in the operating manual explicitly in order to obtain accurate results.

B. Position the intake assembly close to the monitoring area because the low sampling rate allows for only very localized readings. Do not immerse the intake assembly in fluid under any circumstances.

C. While taking care not to permit the PID to be exposed to excessive moisture, di or contamination, monitor the work activity as specified in the site Health a Safety Plan. Conduct the PID survey at a slow to moderate rate of speed a slowly sweep the intake assembly (the probe) from side to side.

D. During drilling activities, perform PID monitoring at every 5-ft interv downhole, at the headspace, and in the breathing zone. In addition, monitori may be performed in the breathing zone during actual drilling when elevat organic vapor levels are encountered. When the activity being monitored does n involve drilling (like surface sampling), readings may only be recorded in t breathing zone. Refer to the site Health and Safety Plan for specific monitori instructions.

E. Be prepared to evacuate the area if the preset alarm sounds. Operators usi supplied air systems may not need to evacuate the work area, but they shou frequently observe the levels indicated by the instrument.

F. Static voltage sources like power lines, radio transmissions, or transformers m interfere with measurements. See the operator's manual for a discussion necessary considerations.

3.4. Postoperation

3.4.1. Field

A. When the activity is completed or at the end of the day, carefully clean t outside of the PID with a damp disposable towel to remove any visible di Return the PID to a secure area and place on charge.

B. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, Gener Equipment Decontamination), and ready for shipment.

C. Make sure all survey or sampling locations are properly staked and the locati ID is readily visible on the location stake.

3.4.2. Documentation

A. Record any uncompleted work (like additional monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial a pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the document control officer (with copie to the site manager and files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damage equipment and charge the batteries. Replace expendable items. Retur equipment to the equipment manager and report incidents of malfunction damage.

4. SOURCES

HNU Systems, Inc. 1986. "Instruction Manual for the Trace Gas Analyzer Model PI 10 Newton, Massachusetts.

CFR 49. 1985. Code of Federal Regulations, Title 49, U.S. Department of Transporatation, Parts 100-177. November 1, 1985. Washington, D.C.: U.S. Government Printing Office.

EPA. 1984. "Characterization of Hazardous Waste Sites--A Methods Manual: Volume II, Available Sampling Methods, Second Edition" U.S. Environmental Protection Agency report EPA-600/4-84-076. Environmental Monitoring Systems Laboratory, Office of Research and Development, Las Vegas, Nevada.

5. APPENDIXES

5.1. Comparison of the FID and PID

5.2. Equipment and Supplies Checklist

5.3. Photoionization Detector Field Data Form

5.4. Data Form Completion

APPENDIX 5.1

COMPARISON OF THE FID AND PID

	FID	PID
Response	Responds to many organic gases and vapors, especially low molecular weight hydrocarbons.	Responds to many organic and some inorganic gases and vapors, especially heavy hydrocarbons.
Application	In survey mode, detects total concentrations of gases and vapors. In GC mode, identifies and measures specific compounds.	In survey mode, detects total concentrations of gases and vapors. Some identification of compounds possible if GC column and standards are used.
Limitations	Does not respond to inorganic gases and vapors with a higher ionization potential than the flame detector. No temperature control.	Does not respond to methane or inorganic aliphatic chlorinated solvents. Does not respond properly in presence of water vapor (high humidity). Does not detect a compound if probe (lamp) has a lower energy than compound's ionization potential.
Calibration gas	Methane and others	Benzene (1,3-butadiene) and others
Ease of operation	Requires experience to interpret correctly, especially in GC mode.	Fairly easy to use and interpret. More difficult in the GC mode.
Detection limits	0.1 ppm (methane)	0.1 ppm (benzene), depends on lamp voltage.
Response time	2-3 sec (survey mode)	3 sec for 90% of total concentration

APPENDIX 5.1, Continued

	FID	PID
Maintenance	Periodically clean and inspect particle filters, valve rings, and burner chamber. Check calibration and pumping system for leaks. Recharge battery after each use.	Clean UV lamp frequently. Check calibration regularly. Recharge battery after each use.
Useful range	0-1000 ppm	0-2000 ppm
Service life	8 hrs; 3 hrs with strip chart recorder	10 hrs; 5 hrs with strip chart recorder

APPENDIX 5.2

EQUIPMENT AND SUPPLIES CHECKLIST

________ Photoionization detector (PID)

________ Operating manual.

________ Probes: 9.5eV______, 10.2eV______, and 11.7eV______

________ Battery charger for PID

________ Spare batteries

________ Jeweler's screwdriver for adjustments

________ Tygon tubing

________ NBS traceable calibration gas (type)__________

________ "T" valve for calibration

________ Intake assembly extension

________ Strap for carrying PID

________ Teflon tubing for downhole measurements

________ Plastic bags for protecting the PID from moisture and dirt

APPENDIX 5.3

PHOTOIONIZATION DETECTOR FIELD DATA FORM

PHOTOIONIZATION DETECTOR FIELD DATA

FACILITY CODE ____________ LOG DATE ____________

LOCATION ID ____________ LOCATION TYPE ____________

LOGGER CODE ____________ FIELD REP ____________

PHOTOIONZATION DETECTOR INSTRUMENT: MODEL ____________

MANUFACTURER ____________ DATE/TIME CALIBRATED ____________

SERIAL NO ____________ ACCEPTANCE CODE ____________

CALIBRATION GASES:	
TYPE/CYLINDER ID NO	CONCENTRATION (PPM)/SPAN
1	1
2	2

COMMENTS ____________

TIME (HH:MM)	SAMPLE ID	OBSERVED READING (ppm)					DRILLING DEPTH (FT)	COMMENTS
		DH	HS	BZ	D	OT		

ACCEPTANCE CODES: A—ACCEPTABLE R—RECONNAISSANCE U—UNACCEPTABLE N—NOT DETERMINED

LOCATION TYPES:
BH – BOREHOLE
SS – SOIL SAMPLE
SL – SURFACE LOCATION
SB – SAMPLE BOTTLE
TP – TEST PIT
WL – WELL
OT – OTHER

OBSERVED READING:
D – DURING DRILLING (BZ)
DH – DOWNHOLE
HS – HEADSPACE
BZ – BREATHING ZONE
OT – OTHER

COMPLETE [illegible]: DATA FOR ENTRY INTO TIMS
[illegible] (1/[illegible])

____
FORM COMPLETED BY/DATE

____
TECHNICAL REVIEWER/DATE

APPENDIX 5.4

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entr each blank. Where there is no data entry, enter UNK for Unknown, NA for Applicable, or ND for Not Done. If any procedure was not performed as prescribed. the reason for the change or omission on the form. To change an entry, draw a si line through it, add the correct information above it, and initial the change.

PHOTOIONIZATION DETECTOR FIELD DATA FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate facility, and the remaining two numbers designate the specific site within facility.

2. Log Date. The date the information recorded on the form was obtainec the format DD-MMM-YY (01-JAN-88).

3. Location ID. Four-character code assigned sequentially to each borehole, pit, or surface location where physical, chemical, biological, radiological, other measurements are taken.

4. Location Type. Two-character code identifying where the sample was ta There is one location type for each location ID. Location types include t listed below.

    BH--Borehole

    TP--Test Pit

    SL--Surface Location

    WL--Well

    SB--Sample Bottle

    SS--Soil Sample

    OT--Other (explain)

5. Logger Code. Three-character or four-character code identifying company responsible for collecting the information on the form.

6. Field Rep. The name of the field representative.

7. PID Model. Model of photoionization detector (PID) instrument.

8. PID Manufacturer. Manufacturer's name on the PID instrument used.

9. Date/Time Calibrated. Last day and time when the PID instrument calibrated. Calibration should be performed daily.

10. Serial No. Serial No. of PID instrument.

11. Acceptance Code. One-character code assigned by the site manager.

12. Calibration Gases

    a) Type/Cylinder ID No. Name of the calibration gas and the identification number of the cylinder.

    b) Concentration (ppm)/span. Concentration of calibration gas in parts per million (ppm) and the span setting for calibration.

13. Comments. Any additional information.

14. Time (HH:MM). The time when a field measurement was taken in the 24-hr clock format of hours:minutes (for example, 08:37 for 8:37 a.m. and 19:12 for 7:12 p.m.). See the conversion table below.

<u>Conversion Table</u>

Conventional Time	24-Hr Time
1:00 a.m.	1:00
12:00 Noon	2:00
1:00 p.m.	13:00
2:00 p.m.	14:00
3:00 p.m.	15:00
4:00 p.m.	16:00
5:00 p.m.	17:00
6:00 p.m.	18:00
7:00 p.m.	19:00
8:00 p.m.	20:00
9:00 p.m.	21:00
10:00 p.m.	22:00
11:00 p.m.	23:00
12:00 Midnight	24:00

15. Sample ID. When samples are being taken during a PID monitoring, the identification number or code assigned to a particular sample (like 01) is correlated with the observed readings and appropriate drilling depth (if drilling is being performed). This is useful in selecting samples for analyses and in the correlation of laboratory data with PID measurements.

16. Observed Reading (ppm). PID reading at the respective location ID in the units indicated on the meter. When the calibration gas and the gas being measured for the environment are the same, the meter reads in parts per million (ppm) during drilling. Readings may be taken downhole, at the headspace, and in the breathing zone, and data should be recorded in the appropriately marked column.

APPENDIX 5.4, Concluded

17. Drilling Depth (Ft). PID monitoring is performed every 5 ft during drilling The depth of the drilling is listed in feet and can be given as the most recen interval (like 5-10) or as the ending depth (like 10).

18. Comments. Any additional information, including the type of gas bein measured if this determination can be made (for example, by labels or drums).

DRAFT PROCEDURE C-6

USE OF HOLLOW STEM AUGER FOR BORING AND SUBSURFACE SOIL SAMPLING

ICF KAISER ENGINEERS Environment Group	ARCSWEST STANDARD OPERATING PROCEDURES	
	BORING AND SUBSURFACE SOIL SAMPLING	SOP NO. 2.2 REV. 3 PAGE 1 OF 3 DATE ISSUED 01/21/92
	PREPARED BY ICF KE NW Offices	APPROVALS Earle Krivanec EK

UNCONTROLLED COPY

2.2.0 INTRODUCTION

This guideline describes the equipment and procedures that are to be used at sites assigned under the ARCSWEST contract for drilling and for collecting soil samples. This SOP is to be used in conjunction with SOP No. 2.1, Well Construction and Development and SOP No. 2.3, Borehole Logging.

2.2.1 EQUIPMENT

The following types of equipment are typically used for boring and subsurface sampling:

- Drill rigs:
    - Hollow stem auger;
    - Air-rotary casing hammer;
    - Dual tube percussion hammer;
    - Cable tool;
    - Mud rotary; or
    - Reverse rotary.
- Hollow stem auger flights.
- Central Mine Equipment Company, 5ft. x 94mm continuous-core barrels.
- Steel drive casing.
- 2.5-inch, 2.0-inch, or 1.5-inch I.D.split-spoon drive sampler.
- 2.5-inch, 2.0-inch, or 1.5-inch brass liners and sealing materials (plastic end caps, Teflon seals, non-adhesive silicon or teflon tape, zip-lock plastic bags).
- Shelby tube sampler.
- Large capacity borehole bailer.
- Foxboro FID-Organic Vapor Analyzer (OVA).
- HNu PID-Organic Vapor Meter.
- Sampler cleaning equipment:
    - Steam cleaner;
    - Generator;
    - Stiff-bristle brushes;

- Buckets;
- High purity laboratory detergent, such as Alconox;
- Methanol or hexane (if necessary);
- 0.1N nitric acid (if necessary);
- Deionized water; and
- Potable water.

2.2.2 TYPICAL PROCEDURES

Follow these procedures for borehole and subsurface sampling:

- Obtain applicable drilling and well construction permits prior to mobilization.

- Obtain clearance of drilling locations for presence/location of underground utilities and structures. Call Underground Service Alert (USA) or equivalent clearinghouse.

- Steam clean all downhole equipment prior to drilling each boring.

- Drill soil borings not to be completed as monitoring wells with an auger rig, using hollow stem augers of appropriate size.

- Grout to the surface all borings not completed as monitoring wells, using a neat cement-bentonite grout (containing approximately 5 percent bentonite).

- When installing monitoring wells, ensure that hollow stem augers or other drilling equipment are of the appropriate size to provide an annular space of 2 inches or more between the borehole wall and well casing.

- Collect soil samples for lithologic logging and chemical and physical analyses by driving a split-spoon drive sampler, in 2.5-foot to 5-foot increments or at intervals specified in the Work Plan before advancing the drilling/auger bit, with a rig-mounted drive hammer. If a sample is not collected at the designated interval due to poor recovery, an attempt will be made to collect the sample from the lower laying soil. In some instances, a Shelby Tube Sampler may be used in lieu of the split-spoon sampler. When collecting samples using the split-spoon drive sampler, record the number of blow counts per six-inch interval measured off of the drill rod (ASTM D-18.21.03). If the sampler is pushed rather than driven, record the push force.

- Classify the soils in the field in approximate accordance with the visual-manual procedure of the Unified Soil Classification System (ASTM-2488), see SOP No. 2.3, Borehole Logging.

- Prior to each sampling event, wash the split-spoon drive sampler with high purity laboratory detergent, and double rinse the components with deionized water and methanol and/or 0.1N nitric acid, as appropriate. Brass liners and Shelby Tube samplers should be laboratory cleaned prior to use and field rinsed with deionized water prior to use.

- At each sampling interval, collect the appropriate number of brass liners for laboratory analysis. Cover the ends of the brass liner with Teflon sheets, or aluminum foil, depending on the constituents of concern, seal the liner with plastic caps, and wrap it with Teflon tape. Place a completed sample label on the brass liner. Bag samples in a ziplock bag at the sampling point. Line each cooler with a trash bag, place the samples in the cooler, pack with vermiculite or other suitable packing material, and seal trash bag with twist tie. If the samples require cooling, add ice to the cooler and fill dry remaining space with packing material.

- As a field screening procedure (if applicable), at each sampling interval put the sample from one of the brass liners into an airtight container and allow it to equilibrate. After this, use an OVA to monitor the headspace in the container. If significant organic vapors are detected with the OVA, save the appropriate brass liners for possible laboratory analysis.
- Complete chain-of-custody forms in the field and transport the samples in insulated containers to the laboratory at an internal temperature of approximately 4°C.
- If applicable, as described in the site safety plan, use an OVA or HNu to analyze ambient air in the breathing zone, the inside of the augers or casing, the spoils (cuttings), and other locations as necessary.

2.2.3 EQUIPMENT CLEANING

(1) Prior to drilling each boring, steam clean or pressure wash downhole equipment (augers, well casing, sampler).

(2) Before collection of each drilling sample, steam clean or wash sampling equipment (sampler and brass liners) with a brush in a solution of high purity phosphate-free soap and potable water. Rinse the equipment with potable water and methanol and/or 0.1N nitric acid, as appropriate. Follow with double-rinsing using distilled water.

(3) At completion of drilling, steamclean downhole equipment and vehicles that require cleaning before leaving the site.

2.2.4 INVESTIGATION-DERIVED WASTES, SPOILS, AND CUTTINGS

Place soil cuttings and other residuals in appropriately labeled containers for disposal by the client (see SOP 6.2, Handling of Investigation-Derived Waste).

DRAFT PROCEDURE C-7

COLLECTION OF SLUDGE SAMPLES
FROM
TANKS USING THE HAND CORER

(as contained in SOP for Soil and Sediment Sampling)

STANDARD OPERATING PROCEDURE
SOIL AND SEDIMENT SAMPLING

3.1.0 PURPOSE

This SOP provides instructions that are to be followed in collecting soil and sediment samples at sites assigned under the ARCSWEST contract. This SOP is to be used in conjunction with SOP No. 3.4, Sample Containers and Preservation, SOP No. 3.5, Request for Analysis Documentation, and SOP No. 3.6, Sample Packaging and Shipment.

3.1.1 SOIL SAMPLING

Soil samples may be collected by either using hand tools, i.e., trowel, shovel, post hole digger, auger, or by a power drive sampling device such as split spoon or Shelby Tube. The sample collection method used should be noted in the field logbook. Sections 3.1.1.1 through 3.1.1.3 provide instructions for soil sampling using hand tools. Section 3.1.1.4 discusses split spoon and Shelby Tube sampling. For hand-tool sampling the following table is provided to aid in selecting the proper tool based on the prescribed depth of the sample.

Depth	Hand Tool
0-1 foot	stainless steel trowel
½-2 feet	shovel
1-6 feet	post hole digger
1-8 feet	auger

Once the sampling location has been selected, all vegetation and loose material shall be removed from a circular area approximately 2 feet in diameter. The purpose of this step is to prohibit surface material from falling into the sample hole and possibly contaminating the sample. Also, a level surface will facilitate hole depth measurements.

To prevent potential surface contamination from any subsurface sample contaminants, plastic sheeting should be placed adjacent to the sample location. All subsurface material that is collected must be placed on this sheeting.

3.1.1.1 Shovel and Trowel

When the prescribed sample depth is less than 2 feet, a decontaminated shovel and stainless steel trowel can be used, following the sequence of steps described below:

(1) Label all bottles with required tags and labels (SOP No. 3.5, Request for Analysis Documentation). Fill out all information except sampler's name/initials and the actual date and time. Sort bottles, one set per sampling location with additional sets as needed for field duplicates.

(2) Note exact location of the sample in the field logbook. If not tied in to a surveyed grid system or some other well documented system, measure distances and direction from stationary landmarks. If possible, photograph the location. As appropriate, spray paint or wooden stakes should be used to mark the location.

(3) At the time of individual sample collection, record date, time, and sampler's name/initials on all sample containers and in the field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

(4) Use a decontaminated shovel to remove the overburden to the prescribed depth and place excavated material on the plastic sheeting.

(5) Remove loose material from the bottom of the hole and place into a decontaminated stainless steel bucket. Attempt to eliminate all non-soil materials from the sample, such as rocks, trash, leaves, etc.

(6) If the samples are being analyzed for volatile organic compounds (VOCs), collect the VOC fraction first. VOC sample containers should be tightly packed, using a decontaminated stainless steel trowel, leaving no airspace in the vial.

(7) Using the trowel, fill the remaining sample containers 3/4 full.

(8) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock bag, and place in a cooler. For sample preservation the cooler should contain ice when specified by the site-specific sample plan.

(9) Replace excavated material from the plastic sheeting into hole and cap with removed vegetation.

(10) Decontaminate the sampling equipment for the next sample. (If possible, have a sufficient quantity of clean decontaminated trowels available so that each of the soil samples can be taken with a separate trowel and decontamination can be performed on all the trowels at the end of the sampling effort rather than between each sample.)

(11) Field soil simple duplicates are to be collected either by compositing the soil in a decontaminated stainless steel bucket (a composited field duplicate) or sampling from a close adjacent location (a collocated field duplicate). Follow the site-specific sample plan and document the duplicate collection process in the field logbook.

3.1.1.2 Post Hole Digger

Depending on the required depth (1 to 6 feet) of the sample, a post hole digger may be used to remove overburden. Most post hole diggers are painted when new. Scrape the paint off prior to sampling.

(1) Label all bottles with required tags and labels (SOP No. 3.5, Request for Analysis Documentation). Fill out all information except sampler's name/initials and the actual date and time. Sort bottles, one set per sampling location with additional sets as needed for field duplicates.

(2) Note exact location of the sample in the field logbook. If not tied in to a surveyed grid system or some other well-documented system, measure distances and direction from stationary landmarks. If possible, photograph the location. As appropriate, spray paint or wooden stakes should be used to mark the location.

(3) At the time of individual sample collection, should record date, time, and sampler's name/initials on all sample containers and in the field logbook. Cover all container labels with wide transparent waterproof tape to ensure label integrity.

(4) Begin removal of overburden with a hole approximately 1 foot in diameter (samples taken from a depth of 5 to 6 feet will require a top-of-hole diameter of 1½ feet). During overburden removal, ensure that cross contamination does not occur.

(5) When the desired level is reached, record depth with a tape measure, remove loose material from the bottom of the hole and place into a decontaminated stainless steel bucket. Attempt to eliminate all non-soil materials from the sample, such as rocks, trash, leaves, etc.

(6) If the samples are being analyzed for VOCs, collect the VOC fraction first. VOC sample containers should be tightly packed using a decontaminated stainless steel trowel leaving no airspace in the vial.

(7) Using the trowel, fill the remaining sample containers 3/4 full.

(8) If VOCs are not an analytical parameter and if a composite sample is preferred, periodically place a small amount of soil in a decontaminated stainless steel bucket (e.g., every foot) and, using a decontaminated stainless steel trowel, mix soil prior to filling sample containers.

(9) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock bag, and place in a cooler. For sample preservation, the cooler must contain ice when specified by the site-specific sample plan.

(10) Measure the total depth of the hole. Sample depth should be recorded as beginning sample depth to final sample depth (i.e., 5.0' to 5.4').

(11) Refill hole using the excavated material. If the sample hole was dug through a clay cap or if downward migration of contaminants is a concern, use bentonite when refilling the hole.

(12) Decontaminate the sampling equipment for the next sample. (If possible, have a sufficient quantity of clean decontaminated trowels available so that each of the soil samples can be taken with a separate trowel and decontamination can be performed on all the trowels at the end of the sampling effort rather than between each sample.)

(13) Field soil sample duplicates are to be collected either by compositing the soil in a decontaminated stainless steel bucket (a composited field duplicate) or sampling from a close adjacent location (a collocated field duplicate). Follow the site-specific sample plan and document the duplicate collection process in the field logbook.

3.1.1.3 Auger

An auger may be used for sample collections between 1 and 8 feet. For sample depths greater than approximately 3 feet, it is usually easier to use a post hole digger to remove overburden prior to sample collection with an auger. Augers do not work well in rocky soils.

(1) Label all bottles with required tags and labels (SOP No. 3.5, Request for Analysis Documentation). Fill out all information except sampler's name/initials and the actual date and time. Sort bottles, one set per sampling location with additional sets as needed for field duplicates.

(2) Note exact location of the sample in the field logbook. If not tied in to a surveyed grid system or some other well-documented system, measure distances and direction from stationary landmarks. If possible, photograph the location. As appropriate, spray paint or wooden stakes should be used to mark the location.

(3) At the time of individual sample collection, record date, time, and sampler's name/initials on all sample containers and in the field logbook. Cover all container labels with wide transparent waterproof tape to ensure label integrity.

(4) On the auger, use a tape measure to locate the appropriate sampler distance from the bottom of the auger and attach a piece of tape to the auger extension to indicate the prescribed sample depth.

(5) Place the auger above the selected sample location and turn the "T" handle clockwise (as viewed from above) to screw the auger into the soil.

(6) Remove soil in approximately 1-foot intervals until sample depth is reached. Expel the "plug" by pushing from the top of the auger. Place excavated material on a plastic sheet.

(7) When the auger is at the desired depth, collect the sample and place into sample containers using a decontaminated stainless steel trowel.

(8) If the samples are being analyzed for VOCs, collect the VOC fraction first. VOC sample containers should be tightly packed using a decontaminated stainless steel trowel leaving no airspace in the vial.

(9) Using the trowel, fill the remaining sample containers 3/4 full.

(10) If VOCs are not an analytical parameter and if a composite sample is preferred, periodically place a small amount of soil in a decontaminated stainless steel bucket (e.g., every foot) and, using a decontaminated stainless steel trowel, mix soil prior to filling sample containers.

(11) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock bag, and place in a cooler. For sample preservation the cooler must contain ice when specified by the site-specific sample plan.

(12) Replace excavated material or use bentonite and cement grout if downward migration of contaminants is a concern.

(13) Decontaminate the sampling equipment for the next sample. (If possible, have a sufficient quantity of clean decontaminated trowels available so that each of the soil samples can be taken with a separate trowel and decontamination can be performed on all the trowels at the end of the sampling effort rather than between each sample.)

(14) Field soil sample duplicates are to be collected either by compositing the soil in a decontaminated stainless steel bucket (a composited field duplicate) or sampling from a close adjacent location (a collocated field duplicate). Follow the site-specific sample plan and document the duplicate collection process in the field log book.

3.1.1.4 Split Spoon/Shelby Tube

A split spoon sampler is used to take subsurface soil or sediment samples by being forcefully driven into the soil at the bottom of a bore hole. Samples may be retrieved along the entire length of the bore hole to obtain an unbroken record of the subsurface layers or at selected intervals. Continuous samples may also be taken from the surface down to a specified level or from a subsurface point downward.

The split spoon is threaded on to the end of the drill rod in place of the drill bit. The bore hole may contain casing (steel or plastic pipe), depending upon future use of the hole and the rigidity of the penetrated formation. The sampler is lowered on the drill rod to the bottom of the boring by heavy steel cable connected to the drilling mast. The sampler is forced into the soil by a drive weight which is dropped repeatedly onto the drive head located at the top of the drill rod. Weights up to 350 pounds are available but the most commonly used for a 2-inch diameter sampler is a 140-pound weight. The weight is typically allowed to fall a distance of 30 inches. The sampler is driven into the sediment to a depth which is about 6 inches shorter than the length of the sampler itself. Split spoon samplers are manufactured in 18- and 24-inch lengths with 2- to 3-inch outside diameters.

Occasionally bedrock or extremely compacted sediments are encountered which make further advance of the sampler extremely difficult or impossible without damage to the sample. This is known as "refusal" and is defined as a "penetration of less than 1 foot for 100 blows"; a blow being the act of striking the drive rod with the drive weight. Six inches for 50 blows is also commonly recognized as refusal. Upon refusal. the bore hole is to be either abandoned or the sampler removed and replaced by a drill bit.

Split spoon sample collection procedure.

(1) Label all bottles with required tags and labels (SOP No. 3.5, Request for Analysis Documentation). Fill out all information except sampler's name/initials and the actual date and time. Sort bottles, one set per sampling location with additional sets as needed for field duplicates.

(2) Note exact location of the sample in the field logbook. If not tied in to a surveyed grid system or some other well documented system, measure distances and direction from stationary landmarks.

If possible, photograph the location. As appropriate, spray paint or wooden stakes may also be used to mark the location.

(3) At the time of individual sample collection, record date, time, and sampler's name/initials on all sample containers and in the field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

(4) Receive sampler from driller and place on a secure bench or rack for opening.

(5) Separate the sample tube (a flat-blade screwdriver is useful), exposing either the sample or, if used, brass liners.

(6) Run a knife between the liners to separate and immediately seal the cut ends with teflon film if VOCs analysis is required. Wrap with teflon plumber's tape, cap with plastic lids, and wrap with grey duct tape. Apply sample label.

(7) If no liner is used, the sample may be collected from the open spoon using decontaminated stainless steel spoons.

(8) If the samples are being analyzed for VOCs, collect the VOC fraction first. VOC sample containers should be tightly packed, using a decontaminated stainless steel trowel, leaving no airspace in the vial.

(9) If VOCs are not an analytical parameter and if a composite sample is preferred, periodically place a small amount of soil in a decontaminated stainless steel bucket (e.g., every foot) and, using a decontaminated stainless steel trowel, mix soil prior to filling sample containers.

(10) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock bag, and place in a cooler. For sample preservation the cooler should contain ice as specified by the site-specific sample plan.

(11) Alternately, field duplicates may be collected either by compositing the soil in a decontaminated stainless steel bucket (a composited field duplicate) or sampling from a close adjacent location (a collocated field duplicate). Collocated field duplicates are to be collected from adjacent liners. Follow the site-specific sample plan and document the duplicate collection process in the field logbook.

A similar type of sampling apparatus is the "Shelby" tube. While the split spoon is a multiple piece sampler, the Shelby tube is a single-piece metal tube of thinner gauge than the split spoon. Like the split spoon, soil is forced into the Shelby tube and stored inside. However because the Shelby tube is typically, advanced hydraulically, it allows the capture of a relatively undisturbed sample. The Shelby tube requires much less effort to push into the soil due to its thinner walls and sharp cutting edge. Care must be taken not to compress the soil sample by forcing the tube deeper than its own length. The entire Shelby tube is sent to the laboratory with the sample inside, while the split spoon allows sampling personnel to take only the amount required.

3.1.2 SEDIMENT SAMPLING

Sediments are the deposited material underlying a body of water. Since streams, lakes, and impoundments are likely to demonstrate significant variations in sediment composition with respect to distance from inflow, discharges, and the like, it is critical to document exact sampling locations by means of triangulation with stable references on the banks of the body of water. The presence of rocks, debris, and organic material may also complicate the sampling and may preclude the use of, or require modification to, some devices in cases where the water level is low, the sediment layer is exposed due to evaporation, stream rerouting, or other means of water loss. In deeper water, with the use of a boat as a sampling base, a stainless steel beaker on an extension pole, corers, or clam-shell type dredges can be utilized. In all situations in a body of water, where sediment and water samples are to be obtained at the same location, water samples must be collected first. This is done because sediment collection activities can disturb the bottom and cause sediment suspension resulting in contaminated water samples. For similar reasons, when sampling in bodies of flowing waters such as streams and rivers, the sediment samples should be collected starting furthest downstream and working upstream.

3.1.2.1 Trowel

Sediment samples can be collected using a garden type trowel, provided the water depth is very shallow (i.e., a few inches). A stainless steel trowel or scoop is recommended due to its inert nature. Single grab samples may be collected or, if the area in question is large, it can be divided into grids and multiple samples can be collected and composited. The procedure outlined below should be followed:

(1) Label all bottles with required tags and labels (SOP No. 3.5, Request for Analysis Documentation). Fill out all information except sampler's name/initials and the actual date and time. Sort bottles, one set per sampling location with additional sets as needed for field duplicates.

(2) Note exact location of the sample in the field logbook. If not tied in to a surveyed grid system or some other well documented system, triangulate and measure distances and direction from stationary onshore landmarks. As appropriate, photograph the location.

(3) At the time of individual sample collection, the record date, time, and sampler's name/initials on all sample containers and in the field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

(4) Insert a decontaminated stainless steel trowel into the sediment and begin to remove material. Avoid collecting large rocks or organic debris.

(5) If the samples are being analyzed for VOCs, collect the VOC fraction first. VOC sample containers should be tightly packed, using a decontaminated stainless steel trowel, leaving no airspace in the vial.

(6) Using the trowel fill the remaining sample containers to about 1/2 inch from the top.

(7) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock bag, and place in a cooler. For sample preservation the cooler must contain ice when specified by the site-specific sample plan.

(8) Decontaminate the sampling equipment for the next sample. (If possible have a sufficient quantity of clean decontaminated trowels available so that each of the sediment samples can be taken with a separate trowel and decontamination can be performed on all the trowels at the end of the sampling effort rather than between each sample.)

(9) Field duplicates for sediments are collected either by compositing the sediment in a decontaminated stainless steel bucket (a composited field duplicate) or sampling from a close adjacent location (a collocated field duplicate). Follow the site-specific sample plan and document the for duplicate collection process in the field logbook.

3.1.2.2 Hand Corer

The hand corer is essentially the same type of thin-wall corer that is used for collecting sediment samples. It has a handle to facilitate driving the corer into the sediment and a check valve on the top to prevent sample washout during retrieval through an overlying water layer.

Hand corers are applicable to the same situations and materials as the trowel described above. However, has the advantage of collecting a relatively undisturbed sample and can thus profile sediment stratification. Some hand corers can be fitted with extension handles which allow collection of sediment samples in water of moderate depth (6 feet). Most corers can be fitted with liners of brass, polycarbonate plastic, or Teflon. The appropriate liner can be chosen to match the type of contamination expected in the sample and the intended analytical procedures.

(1) Label all bottles with required tags and labels (SOP No. 3.5, Request for Analysis Documentation). Fill out all information except sampler's name/initials and the actual date and time. Sort bottles, one set per sampling location with additional sets as needed for field duplicates.

(2) Note exact location of the sample in the field logbook. If not tied in to a surveyed grid system or some other well documented system, triangulate and measure distances and direction's from stationary onshore landmarks. As appropriate, photographs the location.

(3) At the time of individual sample collection, record date, time, and sampler's name/initials on all sample containers and in the field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

(4) Force the corer into the sediment with a smooth continuous motion.

(5) Twist the corer and withdraw it in a single smooth motion. Avoid collecting large rocks or organic debris.

(6) If the samples are being analyzed for VOCs, collect the VOC fraction first. VOC sample containers should be tightly packed, using a decontaminated stainless steel trowel, leaving no airspace in the vial.

(7) Using the trowel fill the remaining sample containers to about 1/2 inch from the top.

(8) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock bag, and place in a cooler. For sample preservation the cooler must contain ice when specified by the site-specific sample plan.

(9) Decontaminate the sampling equipment for the next sample. (If possible have a sufficient quantity of clean decontaminated trowels available so that each of the sediment samples can be taken with a separate trowel and decontamination can be performed on all the trowels at the end of the sampling effort rather than between each sample.)

(10) Field duplicates for sediments are collected either by compositing the sediment in a decontaminated stainless steel bucket (a composited field duplicate) or sampling from a close adjacent location (a collocated field duplicate). Follow the site-specific sample plan and document the duplicate collection process in the field logbook.

3.1.2.3 Gravity Corer

A gravity corer is similar to the hand corer described above, it has a removable tapered nosepiece on the bottom and a ball or other type of check valve on the top. A check valve allows water to pass through the corer on descent but prevents sample washout during recovery. A tapered nosepiece allows the corer to penetrate the sediment and reduces core disturbance during the penetration. Most corers are constructed of brass or steel and many can accept plastic liners and additional weights.

Corers are capable of collecting undisturbed samples of sediments and can thus provide a profile of the sediment stratigraphy. Depending on the compaction of the substrate and the weight of the corer, penetration depths of 30 inches can be obtained. **Care should be exercised when using gravity corers in lagoons or ponds that have liners because penetration depths can exceed that of the substrate and result in damage to the liner materials.**

(1) Label all bottles with required tags and labels (SOP No. 3.5, Request for Analysis Documentation). Fill out all information except sampler's name/initials and the actual date and time. Sort bottles, one set per sampling location with additional sets as needed for field duplicates.

(2) Note exact location of the sample in the field logbook. If not tied in to a surveyed grid system or some other well documented system, triangulate and measure distances and direction from stationary on shore landmarks. As appropriate, photograph the location.

(3) At the time of individual sample collection, record date, time, and sampler's name/initials on all sample containers and in the field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

(4) Measure the depth of the water body using a decontaminated measuring tape. Attach a decontaminated gravity corer to the required length of rope and secure the free end of the rope to a fixed support to prevent accidental loss of the corer. Lower the corer allowing it to fall into the sediment.

(5) Retrieve the corer with a smooth, continuous lifting motion. Avoid bumping the corer or jerking on the rope since this may cause some loss of sample.

(6) Remove the nosepiece from the corer and slide the sample out of the corer into a stainless steel or Teflon pan.

(7) If the samples are being analyzed for VOCs, collect the VOC fraction first. VOC sample containers should be tightly packed, using a decontaminated stainless steel trowel, leaving no airspace in the vial.

(8) Using the trowel fill the remaining sample containers to about 1/2 inch from the top.

(9) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock bag, and place in a cooler. For sample preservation the cooler must contain ice when specified by the site-specific sample plan.

(10) Decontaminate the sampling equipment for the next sample. (If possible have a sufficient quantity of clean decontaminated trowels available so that each of the sediment samples can be taken with a separate trowel and decontamination can be performed on all the trowels at the end of the sampling effort rather than between each sample.)

(11) Field duplicates for sediments are collected either by compositing the sediment in a decontaminated stainless steel bucket (a composited field duplicate) or sampling from a close adjacent location (a collocated field duplicate). Follow the site-specific sample plan and document for duplicate collection process in the field logbook.

3.1.2.4 Clamshell Dredge

Two clamshell type samplers are typically used: the Ponar grab dredge and the Eckman dredge. The Ponar grab is activated by a counter lever system. The two halves of the sampler are opened, latched in place and the sampler is slowly lowered to the bottom. When tension is released on the lowering cable, the latch releases and upward tension on the rope closes the clamshell. The Eckman dredge works in a similar manner except that the two halves of the clamshell snap shut under the action of a strong spring when a messenger is sent down the rope.

Clamshell dredges are capable of sampling most types of sludges and sediments from silty to granular materials. Penetration depths will usually not exceed several inches. These types of samplers, unlike the corers described previously, are not capable of collecting undisturbed samples. In addition, the sampling action of these devices causes agitation currents which may temporarily resuspend some settled solids. This disturbance can be minimized by slowly lowering the sampler over the last half yard and allowing gentle contact with the bottom. With the use of dredges, all overlying water samples should be collected prior to the sediment samples.

(1) Label all bottles with required tags and labels (SOP No. 3.5, Request for Analysis Documentation). Fill out all information except sampler's name/initials and the actual date and time. Sort bottles, one set per sampling location with additional sets as needed for field duplicates.

(2) Note exact location of the sample in the field logbook. If not tied in to a surveyed grid system or some other well documented system, triangulate and measure distances and directions from stationary landmarks. As appropriate, photograph the location.

(3) At the time of individual sample collection, record date, time, and sampler's name/initials on all sample containers and in the field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

(4) Measure the depth of the pond or lagoon using a decontaminated measuring tape. Attach a decontaminated sampler to the appropriate length of rope.

(5) Mark the distance to the bottom on the rope, also place a secondary mark, one yard shallower, to indicate proximity to the bottoms so that the lowering rate can be reduced to prevent unnecessary bottom disturbance.

(6) Open the sampler's jaws until they latch open. **When using the Eckman dredge, extreme care should be taken when opening the dredge prior to sampling (or during decontamination) in order to avoid having the two halves accidentally snap shut on fingers or other parts of the sampler's body**. In the case of the Ponar sampler, from this point on the sampler should be supported only by its rope otherwise the sampler will be tripped and the jaws will close. If the Eckman dredge is being used, the messenger should be threaded onto the rope at this time.

(7) Tie the free end of the rope to a fixed support to prevent accidental loss of the sampler.

(8) Begin lowering the sampler until the proximity mark is reached.

(9) Slow the rate of descent through the last yard until contact is felt.

(10) When using the Ponar sampler, allow the rope to slacken by several inches; in strong currents more slack may be necessary to release the closing mechanism. In the case of the Eckman dredge, the messenger is sent down the rope to trigger the closing spring.

(11) Slowly raise the dredge until it is clear of the water surface.

(12) Place the dredge into a stainless steel or Teflon tray and open it. Lift the sampler clear of the tray.

(13) If the samples are being analyzed for VOCs, collect the VOC fraction first. VOC sample containers should be tightly packed, using a decontaminated stainless steel trowel, leaving no airspace in the vial.

(14) Using the trowel fill the remaining sample containers to about 1/2 inch from the top.

(15) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock bag, and place in a cooler. For sample preservation the cooler must contain ice when specified by the site-specific sample plan.

(16) Decontaminate the sampling equipment for the next sample. (If possible have a sufficient quantity of clean decontaminated trowels available so that each of the sediment samples can be taken with a separate trowel and decontamination can be performed on all the trowels at the end of the sampling effort rather than between each sample.)

(17) Field duplicates for sediments are collected either by compositing the sediment in a decontaminated stainless steel bucket (a composited field duplicate) or sampling from a close adjacent location (a collocated field duplicate). Follow the site-specific sample plan and document the duplicate collection process in the field logbook.

3.1.3 HIGH HAZARD LEVEL SAMPLES

High hazard samples are those that contain hazardous substances in concentrations of over 200 ppm. Typically, these samples are direct chemical waste rather than a contaminant in soil or sediment. Knowledge of the hazardous substance(s) anticipated prior to sampling is imperative. The site-specific Health and Safety plan should document each anticipated chemical and should be consulted to prevent unnecessary danger when handling these samples. Extreme caution must be exercised when obtaining samples in this category.

3.1.4 DIOXINS/FURANS

Any sample suspected of containing dioxins/furans must be treated with extreme caution regardless of the parameter(s) for which it is being analyzed. No extra volume should be taken as the laboratory must dispose of the sample remnants.

DRAFT PROCEDURE C-8

IN SITU GROUNDWATER SAMPLING

BY

HYDROPUNCH

STANDARD OPERATING PROCEDURE
IN SITU GROUNDWATER SAMPLING BY HYDROPUNCH

3.7.0 PURPOSE

This SOP provides general instructions for use of a HydroPunch for in situ collection of groundwater samples from unconsolidated sediments.

3.7.1 INTRODUCTION

A HydroPunch is a sampling tool that allows the rapid collection of groundwater samples from a discrete interval suitable for priority pollutant analysis without the installation of groundwater monitoring wells. Because groundwater samples can be collected quickly without the usual costs of well construction materials and well development, it is an effective and efficient screening technique. It is excellent for vertical profiling or defining the areal extent of a contaminant plume. Additionally, because a HydroPunch is minimally intrusive, it is ideal for use in such areas as residential neighborhoods.

3.7.2 METHODOLOGY

A HydroPunch is approximately five feet long, 1.5 inches in diameter, constructed of stainless steel and teflon, and can collect a 500-ml groundwater sample.

To collect a sample, the HydroPunch is connected to a small-diameter drive-pipe and either driven or pushed hydraulically to the desired sampling depth. A cone penetrometer rig can be used to rapidly push the unit to the desired sampling depth, or the HydroPunch can be connected to soil sampling rods permitting groundwater samples to be collected during conventional drilling and soil sampling operations. The tool has proven to be cost-effective via both applications. A significant consideration for the use of a HydroPunch with a penetrometer rig is that the sampling operation results in minimal impact to the surrounding environment; drill cuttings and development water are not produced.

While the unit is driven through the soil, a sample intake tube is retained in the sample chamber in a watertight housing, preventing cross-contamination. As the target depth is reached, the tool is opened to the aquifer by retracting it 12 to 18 inches, allowing groundwater to fill the probe under hydrostatic pressure with no aeration. A disposable polypropylene screen covers the sampling ports and filters out particulate matter. The interval sampled is approximately 1.5 to 2 feet. A valve at the base of the sample reservoir prevents loss of sample while the probe is removed from the ground. Samples are obtained from the HydroPunch with the use of a bottom-emptying device. Samples are transferred into appropriate containers taking care to minimize aeration of the sample.

The HydroPunch is to be disassembled and steam cleaned prior to beginning work and between sampling intervals. An equipment blank is to be collected to ensure proper decontamination. Following collection of the groundwater sample, the borehole is to be backfilled with five feet of bentonite pellets and tremiegrouted to the surface.

At present, the most common problem encountered with the use of the HydroPunch occurs when a sample is collected from a low-permeability formation. In plastic, low permeability clays, the time required to collect a sample may be 45 minutes or longer. In permeable soils, the HydroPunch may fill in as little as five minutes.

In addition, as the case with any geotechnical tool, the more experience the operator has with the HydroPunch, the better the results. An experienced technician can rapidly make adjustments in the field for specific hydrogeologic or drilling conditions encountered and maximize the effectiveness of the tool.

3.7.3 REFERENCES

Edge, R.W., and Cordry, K., "The HydroPunch^{tm}: An In Situ Sampling Tool for Collecting Groundwater from Unconsolidated Sediments," Groundwater Monitoring Review, Summer, 1989.

DRAFT PROCEDURE C-9

GROUNDWATER

AND

SURFACE WATER SAMPLING

STANDARD OPERATING PROCEDURE
GROUNDWATER AND SURFACE WATER SAMPLING

3.2.0 PURPOSE

This SOP provides instructions that are to be followed in collecting groundwater and surface water samples at sites assigned under the ARCSWEST contract. This SOP is to be used in conjunction with SOP No. 3.4, Sample Containers and Preservation, SOP No. 3.5, Request for Analysis Documentation, and SOP No. 3.6, Sample Packaging and Shipment.

3.2.1 GROUNDWATER SAMPLING

There are many types of wells from which groundwater samples may be collected, including monitoring wells, public wells, residential wells, industrial wells, irrigation wells, and livestock wells, all with a wide range of diameters, depths, and construction features. As part of field planning activities, the following information about the well(s) should be obtained:

- Well owner;
- Well driller;
- Type of well (monitoring, residential, etc.)
- Well depth and diameter;
- Well condition;
- Well elevation and reference point;
- Type of casing;
- Screen depth(s) and length(s);
- Well logs (if possible);
- Previous sampling data;
- Depth to groundwater;
- Pump capacity;
- Water treatment process (fluoride, water softeners, etc.); and
- Spigot location (i.e., before or after treatment process).

3.2.1.1 Monitoring Well Purging

Prior to collecting groundwater samples from a monitoring well, the well should be purged to remove any stagnant water from the well casing and draw water from the formation so that representative groundwater samples can be obtained. The well has been sufficiently purged when consecutive measurements of specific conductivity, pH, and temperature have stabilized to within 10 percent of one another. These measurements are to be taken from samples drawn from the well before purging is started and at regular intervals thereafter. For estimation purposes, it can be assumed that the required purge volume will be within three to five well casing volumes. The formula for determining a well casing volume is:

$$Vc = \pi r^2 h$$

Where: Vc = well casing volume
π = 3.14
r = well casing radius
h = water column height in casing

By incorporating π and necessary conversion factors into a single constant, the following formula is obtained:

$$Vc = 0.041\ d^2h$$

Where:
Vc = well casing volume in gallons
d = well casing diameter in inches
h = water column height in casing in feet

The second formula is easier to apply in the field. Alternately, the following chart provides well casing volumes for the commonly encountered well casing diameters.

Well Diameter (inches)	Gallons Of Fluid Per Linear Foot
1	0.04
2	0.16
3	0.37
4	0.65
6	1.47
8	2.61
10	4.08
12	5.88

Example: If a well casing has a diameter of 4 inches, a total depth of 55 feet, and a depth to static water level of 15 feet, then the well casing volume would be:

55 ft - 15 ft = 40 lineal ft

40 ft x 0.65 gallons/ft = 26 gallons

Steps to consider when purging and sampling include:

- Begin purging and sampling the least contaminated wells first (as practicable) to minimize potential transfer of contaminants between wells.
- After the purging has been completed, always don new gloves and use a new bailer suspension cord and a decontaminated bailer when taking this sample. Tripods and any other equipment that were used for purging must also be decontaminated before taking samples.
- Avoid allowing the bailer suspension cord to touch the ground. A large plastic bag placed inside an empty drum is suitable for containing the suspension cord.
- After each use decontaminate the beaker used for obtaining water parameters.
- After each reading, blot dry and decontaminate the pH probe, conductivity probe, and thermometer with deionized water.
- Decontaminate the pump and all accessories that are placed in the well. Most bladder pumps can be disassembled and cleaned. Most submersible pumps can not be easily decontaminated; thus it is important to ensure that the pump is flushed and cleaned after each use.

3.2.1.1.1 Purging With Bailers

For monitoring wells, the most common purging device is a bailer. Bailers are usually made of PVC, stainless steel, or Teflon. The widest and largest bailer that will comfortably fit down the well is recommended for use. (In finer-grained aquifers, use under-sized bailers so as to avoid creating suction upon bailer removal which could cause formation erosion.)

The following steps must be followed at each well. Procedural modifications may be necessary based on conditions and sound engineering judgement. However, if modifications are required and made, the variances from this SOP must be fully documented in the field logbook.

(1) Prior to approaching the well, the HNu or OVA operator must be in the appropriate level of protection as prescribed in the Site Health and Safety Plan. The well shall be unlocked as necessary and the inner casing uncapped from an position located upwind, but not so as to not block the wind. The breathing zone and headspace must be monitored with the HNu or OVA upon well opening to measure any volatile organic compounds (VOCs) and ensure proper protection of those working around the wellhead.

(2) The depth to water and total depth of the well should be measured with a water level indicator, using a chalked steel tape with weighted end, electric sounder, or other method. A direct reading with an electric sounder should be made as soon as the probe contacts the water. Several readings are to be obtained and, when the readings are consistent, the depth is to be recorded. Note the location of the reference point for these measurements. Typically there is a mark at the top of the inner casing made by the drillers or surveyors. Always decontaminate equipment before and after each use.

(3) Determine the well water volume and minimum purge quantities required using the formula presented above.

(4) To initiate purging, tie clean bailer suspension cord securely to the bailer and lower the bailer into the well to below the water level. Allow time for the bailer to fill before hauling it back up. Make certain that the Teflon or stainless steel ball properly seals. (Clean off any sediment at bottom of bailer with deionized water.) If a proper seal cannot be achieved, use another decontaminated bailer and cord.

(5) During purging, periodically measure for VOCs with a HNu or OVA, and measure water temperature, pH, and conductivity. Measurements shall be taken in a beaker which shall be cleaned and dried after each use. Obtain at least three to five readings at 5 minute intervals. Conductivity and pH may change rapidly when initially purging and then begin to stabilize with increased purge volume. If the well becomes dry before the minimum amount is purged, allow it to recharge so that sufficient volume is available for sampling. Since the well has been purged dry and new water has entered the water column, further purging should not be necessary.

(6) The purged water shall be containerized and not allowed to fall back into the well or onto the ground. A plastic bag should be used to hold excess bailer suspension cord and to prevent suspension cord contact with the ground. It may be helpful to use a tripod with a pulley over the well as an aid in purging.

(7) Purge until pH, conductivity, and temperature readings are stable and a minimum amount has been purged. If the parameters do not stabilize after a maximum amount has been purged, stop purging, and note in the logbook that the parameters did not stabilize prior to sampling. Document to approximate volume purged in the field logbook.

3.2.1.1.2 Purging With Pumps

When wells are purged with pumps, the pump materials and design must be compatible with the suspected contaminants. The purge rate should not exceed the well development rate, as this would cause additional development, and considerably more water may be removed than is necessary to stabilize pH, conductivity, and temperature values. For purging with pumps, follow all steps described above in Section 3.2.1.1.1 except Step 4; substitute the following for step 4:

Complete piping and electrical wire connections as necessary to the pump and lower it to the desired level at approximately the mid-point of the screen. Start the pump and ensure that the intake port does not become exposed to the air. Observe the pump discharge. If the discharge is turbid, stop operations and raise the pump 1 to 2 feet and repeat operation.

3.2.1.2 Monitoring Well Sampling

After purging is completed, monitoring well samples are to be collected. It may be necessary to allow the well to recharge before collecting the sample. The well must be sampled within 24 hours after purging and should be sampled immediately after purging if conditions allow.

The following steps shall be followed at each well. Procedural modifications may be necessary based on conditions and sound engineering judgement. If modifications made, the variances from this SOP shall be fully documented in the field logbook.

(1) Label all sample containers with all appropriate tags and labels. Complete all information except sampler's name/initials and the actual date and time. Sort sample containers, one set per well with additional sets for field duplicates.

(2) Record water parameters (temperature, pH, and conductivity) for the sample. Record date, time, and sampler's name/initials on all sample containers and in the field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

(3) Change gloves and obtain new bailer suspension cord and a decontaminated bailer to collect the sample.

(4) Slowly lower bailer into well to obtain sample and retrieve carefully.

(5) Collect the VOC sample first, (see procedure below), directly from the bailer. Fill remaining grab-sample containers directly from bailer.

<u>VOC Sample Container Filling Procedure</u>. The VOC sample containers required are 40-ml glass vials with septum. These vials shall be slowly filled until a convex meniscus forms above the top of the vial. Allow the sample to reach equilibrium; permit air bubbles to rise to the surface for several seconds. Place the cap over the mouth of the vial so that the septum is properly oriented and screw down the cap firmly. Invert the vial to observe any entrapped air bubbles. Tap the vial be on the palm of the hand to dislodge air bubbles. If bubbles are detected, open the vial and add additional sample, secure the vial and check for air bubbles as described above. If preservatives are contained in sample vials, do not overfill.

(6) When collecting a non-filtered metal fraction, add metals-grade (Ultrex or equivalent) nitric acid either before or after collecting sample. The volume required will depend on the pH of the sample, and may range from 0.5 ml up to 10 ml, but will probably be about the same for samples collected from the same source. To check for pH less than 2, pour a few drops of the preserved sample on a strip of wide-range pH paper.

(7) To filter a sample for metals using an intermediate "transfer vessel," perform the following steps.

    (a) Obtain a decontaminated transfer vessel and pour at least 100 ml of sample into transfer vessel. Using hand pump, pump sample through and discard into waste bucket.

    (b) Open transfer vessel and fill with sample from the bailer. Screw on disposable filter and pump sample through, allowing the first 10 or 20 ml to fall into waste bucket before filling the sample container. Metals-grade (Ultrex or equivalent) nitric acid may be added before or after sample collection. Check for pH less than 2 by pouring a few drops of preserved sample onto wide range pH paper.

(8) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock bag, and place in a cooler. For sample preservation the cooler must contain ice or blue ice when specified by the site-specific sample plan.

(9) Bag contaminated equipment (bailers, buckets, beakers, etc.), remove tripod, containerize disposables, and recap well.

(10) Decontaminate the outside of the sample container and bag samples in a ziplock bag at the sampling point. Line each cooler with a trash bag packed with vermiculite, and seal trash bag with twist tie. Return to the command post for decontamination.

(11) There are various techniques for collecting groundwater duplicates. Follow the site-specific sample plan and document the duplicate collection process in the field logbook.

3.2.1.2.1 Sampling with a Kemmerer

A Kemmerer is widely used for sampling groundwater primarily in situations where a sample is needed from a discrete depth, for example, in the case of dichloroethane which tends to sink to the bottom of an aquifer. The Kemmerer is a messenger-activated sampling device. When the device is open, water flows through the sampler. Once lowered to a desired depth of sampling, a messenger is dropped down the sample line, tripping a release mechanism that closes the device. As it closes, the bottle is sealed on top and bottom.

The following steps should be performed when using the Kemmerer.

(1) Label all sample containers with all appropriate tags and labels. Complete all information except sampler's name/initials and the actual date and time. Sort sample containers, one set per well with additional sets for field duplicates.

(2) Record water parameters (temperature, pH, and conductivity) for the sample. Record date, time, and sampler's name/initials on all sample containers and in the field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

(3) Inspect the decontaminated Kemmerer, make sure that the sample drain valve is closed, if the bottle is so equipped.

(4) Mark the sample line after measuring to the desired sample depth.

(5) Open the Kemmerer by lifting the top stopper-trip head assembly.

(6) Lower the Kemmerer slowly to the desired level and release the messenger on the sample line.

(7) Retrieve the Kemmerer, holding it by the center stem.

(8) Recover the sample by lifting the top stopper and carefully pouring water into the sample containers, or, if a drain valve is available, open the valve over the sample bottle.

(9) Collect the VOC sample first, (see procedure below), directly from the bailer. Fill remaining grab-sample containers directly from bailer.

<u>VOC Sample Container Filling Procedure</u>. The VOC sample containers required are 40-ml glass vials with septum. These vials should be slowly filled until a convex meniscus forms above the top of the vial. Allow the sample to reach equilibrium; permit air bubbles to rise to the surface for several seconds. Place the cap over the mouth of the vial so that the septum is properly oriented and screw down the cap firmly. Invert the vial to observe any entrapped air bubbles. Tap the vial on the palm of the hand to dislodge air bubbles. If air bubbles are detected, discard the sample and collect another in a new VOA vial. If preservatives are contained in sample vials, do not overfill.

(10) When collecting a non-filtered metal fraction, add metals-grade (Ultrex or equivalent) nitric acid either before or after collecting sample. The volume required will depend on the pH

of the sample, and may range from 0.5 ml up to 10 ml, but will probably be about the same for samples collected from the same source. To check for pH less than 2, pour a few drops of the preserved sample on a strip of wide-range pH paper.

(11) To filter sample for metals using an intermediate "transfer vessel," perform the following steps.

(a) Obtain a decontaminated transfer vessel and pour at least 100 ml of sample into transfer vessel. Using hand pump, pump sample through and discard into waste bucket.

(b) Open transfer vessel and fill with sample from the bailer. Screw on disposable filter and pump sample through, allowing the first 10 or 20 ml to fall into waste bucket before filling the sample container. Metals-grade (Ultrex or equivalent) nitric acid may be added before or after sample collection. Check for pH less than 2 by pouring a few drops of preserved sample onto wide range pH paper.

(12) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock bag, and place in a cooler. For sample preservation the cooler must contain ice or blue ice when specified by the site-specific sample plan.

(13) Bag contaminated equipment (bailers, buckets, beakers, etc.), remove tripod, containerize disposables, and recap well. Return to the command post for decontamination.

(14) There are various techniques for collecting groundwater duplicates. Follow the site-specific sample plan and document the duplicate collection process in the field logbook.

3.2.2 DRINKING WATER AND IRRIGATION WELL SAMPLING PROCEDURES

When obtaining samples from drinking water sources, the sample should be taken, if possible, before any treatment process begins (for example, water softeners, chlorine, or fluoride additives.) If this is not possible, it is important to completely document the treatment process in the field logbook. This information will be used in the sample data analysis.

The following steps shall be followed when taking samples from drinking water wells.

(1) Determine the well volume (if possible) and minimum purge quantities. If the well volume is unknown, the spigot closest to the well should be turned on and allowed to flow until pH, temperature, and conductivity values have stabilized. Generally, these wells can be purged onto the ground, unless contamination is known, in which case the purged water must be disposed appropriately.

(2) Label all samples containers with all appropriate tags and labels. Fill out all information except sampler's name/initials, and the actual date and time. Sort sample containers, one set per well with additional sets for field duplicates.

(3) While purging, pH, conductivity, and temperature measurements should be taken and recorded approximately every 5 minutes until stabilized.

(4) After purging, the sample should be taken immediately. Samplers must wear appropriate gloves. Sample containers shall be filled directly from the spigot.

(5) Collect the VOC sample first. The flow of water should be turned down to approximately 10-ml/minute when collecting VOC samples.

<u>VOC Sample Container Filling Procedure</u>. The VOC sample containers required are 40-ml glass vials with septum. The water flow should be turned down to approximately 10 ml/minutes. Vials must be slowly filled until a convex meniscus forms above the top of the vial. Allow the sample to

reach equilibrium; permit air bubbles to rise to the surface for several seconds. Place the cap over the mouth of the vial so that the septum is properly oriented and screw down the cap firmly. Invert the vial to observe any entrapped air bubbles. Tap the vial on the palm of the hand to dislodge air bubbles. If air bubbles are detected, open the vial and add additional sample to the vial, secure it and check for air bubbles as described above. If preservatives are contained in sample vials, do not overfill.

(6) When collecting a non-filtered metal fraction, add metals-grade (Ultrex or equivalent) nitric acid either before or after collecting sample. The volume required will depend on the pH of the sample, and may range from 0.5 ml up to 10 ml, but will probably be about the same for samples collected from the same source. To check for pH less than 2, pour a few drops of the preserved sample on a strip of wide-range pH paper.

(7) To filter sample for metals using an intermediate "transfer vessel," perform the following steps.

   (a) Obtain a decontaminated transfer vessel and pour at least 100 ml of sample into transfer vessel. Using hand pump, pump sample through and discard into waste bucket.

   (b) Open transfer vessel and fill with sample from the bailer. Screw on disposable filter and pump sample through, allowing the first 10 or 20 ml to fall into waste bucket before filling the sample container. Metals-grade (Ultrex or equivalent) nitric acid may be added before or after sample collection. Check for pH less than 2 by pouring a few drops of preserved sample onto wide range pH paper.

(8) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock bag, and place in a cooler. For sample preservation the cooler must contain ice or blue ice when specified by the site-specific sample plan.

(9) Bag contaminated equipment (bailers, buckets, beakers, etc.), remove tripod, containerize disposables, and recap well. Return to the command post for decontamination.

(10) There are various techniques for collecting groundwater duplicates. Follow the site-specific sample plan and document the duplicate collection process in the field logbook.

3.2.3 SURFACE WATER SAMPLING

Surface water sampling may include the sampling of rivers, streams, discharges, ponds, lakes, and impoundments. In moving bodies of water, stand downstream from the flow so as to minimize sediment disturbance. The procedures for sampling are as follows.

(1) Label all sample containers with all appropriate tags and labels. Fill out all information except sampler's name/initials, and the actual date and time. Sort sample containers, one set per sampling location with additional sets as needed for blanks and duplicates.

(2) Note exact location of the sample in the logbook, measuring distances and direction from stationary landmarks, and, if possible, photograph the location.

(3) Record date, time, and sampler's name/initials on all sample containers and in field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

(4) To collect sample, submerge the sample container and fill with sample, adding preservatives after sample is collected.

(5) Collect the VOC sample first, as described below.

<u>VOC Sample Container Filling Procedure</u>. The VOC sample containers required are 40-ml glass vials with septum. These vials shall be slowly filled until a convex meniscus forms above the top of the vial. Allow the sample to reach equilibrium; permit air bubbles to rise to the surface for

several seconds. Place the cap over the mouth of the vial so that the septum is properly oriented and screw down the cap firmly. Invert the vial to observe any entrapped air bubbles. Tap the vial on the palm of the hand to dislodge air bubbles. If air bubbles are detected, open the vial and add additional sample, secure it and check for air bubbles as described above. If preservatives are contained in sample vials, do not overfill.

(6) When collecting a non-filtered metal fraction, add metals-grade (Ultrex or equivalent) nitric acid either before or after collecting sample. The volume required will depend on the pH of the sample and may range from 0.5 ml up to 10 ml, but will probably be about the same for samples collected from the same source. To check for pH less than 2, pour a few drops of the preserved sample on a strip of wide-range pH paper.

(7) To filter sample for metals using an intermediate "transfer vessel," perform the following steps.

   (a) Obtain a decontaminated transfer vessel and pour at least 100 ml of sample into transfer vessel. Using hand pump, pump sample through and discard into waste bucket.

   (b) Open transfer vessel and fill with sample from the bailer. Screw on disposable filter and pump sample through, allowing the first 10 or 20 ml to fall into waste bucket before filling the sample container. Metals-grade (Ultrex or equivalent) nitric acid may be added before or after sample collection. Check for pH less than 2 by pouring a few drops of preserved sample onto wide- range pH paper.

(8) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock bag, and place in a cooler. For sample preservation the cooler must contain ice or blue ice when specified by the site-specific sample plan.

(9) Bag contaminated equipment (bailers, buckets, beakers, etc.), remove tripod, containerize disposables, and recap well. Return to the command post for decontamination.

(10) Field duplicates for surface water are collected consecutively from the same sampling location. Follow the site-specific sample plan and document the duplicate collection process in the field logbook.

3.2.4 HIGH HAZARD LEVEL SAMPLES

High hazard samples are those samples that have concentrations greater than 200 ppm of hazardous substances. Typically, these samples are direct chemical waste rather than a contaminant in water. Knowledge of the hazardous substance(s) anticipated prior to sampling is imperative. The site-specific Health and Safety plan should document each anticipated chemical and should be consulted to prevent unnecessary danger when handling these samples. Extreme caution must be exercised when obtaining samples in this category.

3.2.5 DIOXINS/FURANS

Any sample suspected of containing dioxins/furans must be treated with extreme caution regardless of the parameter(s) for which it is being analyzed. No extra volume should be taken as the laboratory must dispose of the sample remnants.

DRAFT PROCEDURE C-10

FIELD MEASUREMENT OF TOTAL PETROLEUM HYDROCARBONS USING THE HANBY METHOD

FIELD MEASUREMENT OF AROMATICS AND PETROLEUM HYDROCARBONS BY THE HANBY METHOD

1.0 PURPOSE

This procedure describes the field analysis of water and soil samples for aromatics and petroleum hydrocarbons by the Hanby Method.

2.0 SCOPE

2.1 Applicability

The procedure applies to all personnel responsible for obtaining field measurements of petroleum hydrocarbons and aromatics during site characterization work for the Environmental Restoration Program.

2.2 Training

The field team member shall be familiar with the objectives of petroleum hydrocarbon and aromatic sampling and must document that they have read and understand this procedure and all procedures in Section 1 (General Instructions) of the LANL ER SOP manual.

3.0 DEFINITIONS

N/A

4.0 BACKGROUND

The Hanby Method is an extraction/colorimetric method for measuring concentrations of specific petroleum hydrocarbons and aromatics in field samples. After performing a simple direct extraction technique, a special reagent for color development is added; hue and intensity are then compared to color standards. The method has been demonstrated to be highly accurate. Minimum detection limits are typically 1 ppm for most constituents in soils and 0.1 ppm in water. The Hanby Method has been documented in EPA report number 530/UST-90/003 Field Measurements: Dependable Data When You Need It, published September 1990.

5.0 EQUIPMENT

Equipment to implement this procedure is listed on the Equipment and Supplies Checklist for the Hanby Method Field Analysis Test Kit (Attachment A).

6.0 PROCEDURE

A. Refer to the site work plan to locate the sampling sites designated for Hanby Method analysis and the appropriate decontamination area.

B. Decontaminate all reusable sampling equipment before taking the first sample and between sampling intervals in accordance with SOP-02.07, General Equipment Decontamination.

C. For soil samples follow the steps below:

   1. Place a five-gram soil sample (approx. 2 ml) in a beaker.

   2. Add a 10 ml ampule of solvent to the sample and agitate for 3 minutes.

   3. Allow soil to settle and then pour solvent into a screw-top test tube to the 4.2 ml mark.

   4. Add one vial of color development catalyst to the test tube and shake vigorously for three minutes.

   5. Compare the hue and intensity to color standards to determine the contaminant type and concentration.

   6. Record analysis results in ink in the field notebook.

   7. Ensure that all reusable equipment is accounted for, decontaminated, and properly stored. Inform equipment manager of test kit supply needs.

D. For water samples follow the steps below:

   1. Place a 500 ml water sample in a separatory funnel and set in a ringstand.

2. Add a 5 ml ampule of extraction reagent to the water sample and shake the funnel vigorously for two minutes (release pressure build up occasionally, if necessary).

3. Set funnel aside for five minutes allowing the extraction phase to separate to the bottom.

4. After phase separation, drain the lower extraction level into a screw-top test tube to the 4.2 ml mark leaving a small amount of extraction solvent in the funnel.

5. Add one vial of color development catalyst to the test tube and shake vigorously for two minutes or until a uniform color develops.

6. Compare the hue and intensity to color standards to determine the contaminant type and concentration.

7. Record analysis results in ink in the field notebook.

8. Ensure that all reusable equipment is accounted for, decontaminated, and properly stored. Inform equipment manager of test kit supply needs.

7.0 REFERENCES

Section 1.0 General Instructions, LANL-ER-SOP Manual

LANL-ER-SOP-2.07, General Equipment Decontamination (draft).

EPA (US Environmental Protection Agency), September 1990. "Field Measurements: Dependable Data When You Need It," EPA 530/UST-90/003, Washington, DC.

8.0 RECORDS

Hanby Method field analysis results will be recorded in the field notebook. Data to be recorded should include the date and time of day, location and type of sample, and the sample collector. Additional information should include comments concerning the sampling event and sample results (e. g. need for further evaluation).

9.0 ATTACHMENTS

A. Equipment and Supplies Checklist for the Hanby Method Field Analysis Test Kit

EQUIPMENT AND SUPPLIES CHECKLIST FOR HANBY METHOD FIELD ANALYSIS TEST KIT

______ 10-ml graduated cylinder

______ 50-ml beaker

______ 500-ml separatory funnel

______ Extraction reagent ampules (one for every analysis, 30 supplied in kit)

______ Color development reagent (one for every analysis, 30 supplied in kit)

______ Tripod ring-stand

______ Color chart for test results

______ Safety glasses

______ Plastic gloves

APPROXIMATE CONVERSION FACTORS

FOR SELECTED SI (METRIC) UNITS

Multiply SI (Metric) Unit	**By**	**To Obtain US Customary Unit**
Cubic meters (m^3)	35	Cubic feet (ft^3)
Centimeters (cm)	0.39	Inches (in.)
Meters (m)	3.3	Feet (ft)
Kilometers (km)	0.62	Miles (mi)
Square kilometers (km^2)	0.39	Square miles (mi^2)
Hectares (ha)	2.5	Acres
Liters (L)	0.26	Gallons (gal.)
Grams (g)	0.035	Ounces (oz)
Kilograms (kg)	2.2	Pounds (lb)
Micrograms per gram (mg/g)	1	Parts per million (ppm)
Milligrams per liter (mg/L)	1	Parts per million (ppm)
Celsius (°C)	9/5 + 32	Fahrenheit (°F)