RFI Work Plan for Operable Unit 1098

Environmental Restoration Program

June 1993

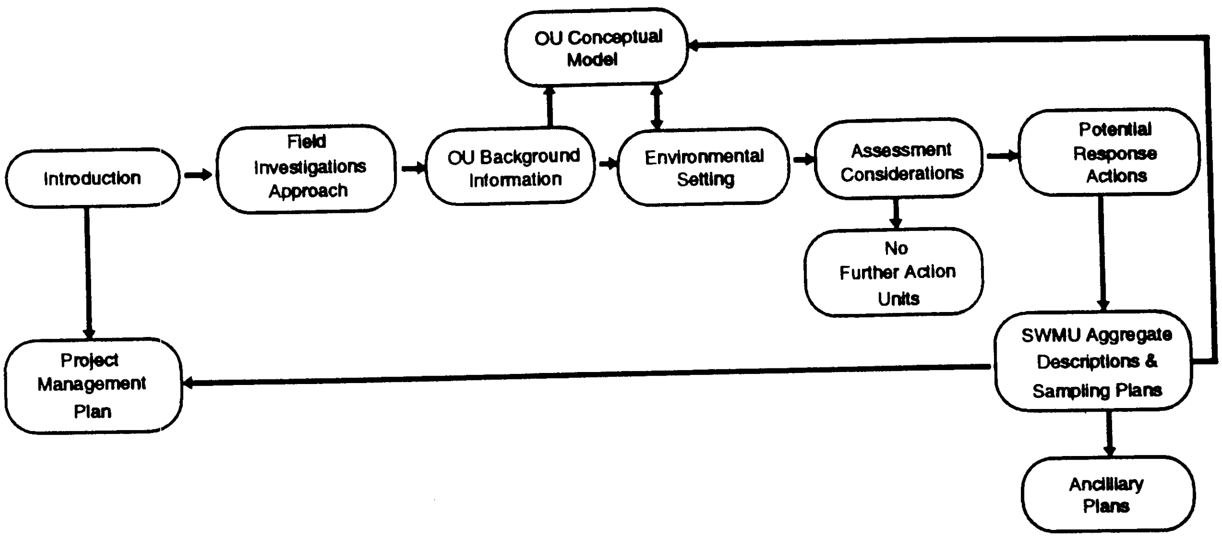
A Department of Energy Environmental Cleanup Program

FINAL DRAFT

Los Alamos
NATIONAL LABORATORY

LA-UR-92-3825

EXECUTIVE SUMMARY



RFI Work Plan
for
Operable Unit 1098
Environmental
Restoration Program

EXECUTIVE SUMMARY

E.1 Introduction

E.1.1 Purpose

The work plan for Operable Unit 1098 (OU 1098) includes Technical Area-2 (TA-2) and Technical Area-41 (TA-41) within Los Alamos Canyon. Within OU 1098, there are 22 potential release sites (PRSs), which are located within the Laboratory. This work plan, as part of the University of California (UC) operated Los Alamos National Laboratory's (hereafter referred to as the Laboratory) Environmental Restoration (ER) Program, is designed to serve two purposes:

- Satisfy the regulatory requirements of the Hazardous and Solid Waste Amendments (HSWA) Module VIII of the Laboratory's Resource Conservation and Recovery Act (RCRA) Part B operating permit, and
- Serve as the field characterization plan for personnel who will implement the RCRA Facility Investigation (RFI). Results from the RFI will lead to a decision about the necessity for a Corrective Measures Study (CMS).

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

E.1.2 HSWA Requirements

Sites to be investigated and evaluated by the ER Program include not only solid waste management units (SWMUs) described in the HSWA Module but sites that contain radioactive materials and other substances not addressed by RCRA. These sites are called areas of concern (AOCs). In this document, SWMUs and AOCs are collectively referred to as PRSs. HSWA Module VIII provides a schedule for addressing 603 SWMUs that the EPA has selected from PRSs identified by the Laboratory. This RFI work plan is designed to address all PRSs within OU 1098 and will be submitted to the EPA and the New Mexico Environment Department (NMED) by June 4, 1993, according to HSWA permit modification schedule.

This work plan addresses ten (1.7%) of the 603 SWMUs listed in Table A of Module VIII of the RCRA permit [2-005, systematic leak due to cooling tower drift loss; 2-007, decommissioned septic system; 2-008(a), inactive outfall; 2-009(a, b, c), inactive operational releases; 41-001, inactive septic system; and 41-002(a, b, c), sewage treatment plant] of the Laboratory's HSWA Module. There are a total of 17 SWMUs within the boundaries of OU 1098. Three SWMUs are contained in the 182 SWMUs appearing on the permit Table B list of priority SWMUs [2-005, systematic leak due to cooling tower drift loss; 2-008(a), inactive outfall; and 41-001, inactive septic system]. This work plan thus contributes to the Laboratory's commitment to address cumulative totals of 55% of Table A SWMUs and 100% of Table B SWMUs by May 1993, as required by the HSWA Module. The Laboratory's November 1990 SWMU report lists 13 SWMUs at TA-2 which are subdivided into 36 subunits. There are four SWMUs and five AOCs associated with TA-41. One of the SWMUs (41-002) is subdivided into three SWMU subunits. These 17 SWMUs and five AOCs are addressed in this work plan. This plan proposes no new SWMUs or AOCs to add to this list.

Technical Area-2 contains SWMUs consisting of an underground diesel fuel tank, decommissioned reactor waste units, storage pits and tanks, cooling tower drift loss, waste lines, drains, a decommissioned septic system, outfalls, operational releases, and chemical shack waste units. Materials used or stored at TA-2 include uranium, tritium, plutonium, various fission products, chromium, mercury, acids, solvents, and polychlorinated biphenyls (PCBs).

The four SWMUs identified at TA-41 include a septic system, sewage treatment plant, sump, and a container storage area. Materials used or stored at TA-41 included uranium, plutonium, tritium, lithium, mercury, beryllium, lead, cadmium, explosives, toxic gases, organic chemicals, and thermite-type heat generators. The SWMU report lists five AOCs for TA-41, which include a sump, a 560-gal. diesel tank, an industrial waste tank (which may have never existed), contaminated storm drains, and a fuel tank with unknown origin.

The total number of PRSs (17 SWMUs and five AOCs) within OU 1098 at TA-2 and TA-41 may contribute to contamination of a shallow alluvial aquifer that occurs in Los Alamos Canyon. The aquifer is contaminated with radionuclides, primarily tritium and fission products (strontium-90 and cesium-137). Thus, one important issue to be addressed is whether or not OU 1098 contains source terms for the alluvial aquifer contamination.

Four SWMUs (2-001, burn site; 2-002, inactive container storage area; 2-013, active hazardous waste container storage area; and 41-004, container storage area) and three AOCs (C-41-002, a 560-gal. diesel tank; C-41-003, an industrial waste tank; and C-41-005, a fuel tank) are proposed for no further action (NFA). A fourth AOC, C-41-001, is addressed as SWMU 41-003 in Section 7.16. Therefore the AOC C-41-001 will also be proposed for NFA since the AOC does not exist as a separate unit. Solid Waste Management Unit 2-001 is inactive. The 55-gal. drum was used to burn paper and other nonhazardous materials, and is no longer used. There were no known releases of hazardous or radioactive materials. Solid Waste Management Unit 2-002, involving past spillage of polychlorinated biphenyls (PCBs), has been remediated to 1 ppm in soil, pavement, and a storm drain. The area is inactive and no radioactive releases have occurred. Solid Waste Management Unit 2-013 has been inspected and there are no visual indications that solvents were spilled or discharged. The diesel tank, C-41-002, leaked in the past, but the area was decontaminated and no further contamination has occurred. Two other AOCs, an industrial waste tank (C-41-003) and a fuel tank (C-41-005), may never have existed, and no evidence of contamination associated with these structures has been documented. The storm drains, C-41-004, have never been sampled. The drains are a site of potential contamination by tritium outfall from the stack at

TA-41, and therefore will be sampled. The effect of the tritium fallout will also be assessed via the baseline soil and stream sediment transect sampling for OU 1098.

E.1.3 Installation Work Plan

The HSWA Module requires that an installation-wide work plan be prepared to describe the system by which all RFI/CMS (Corrective Measures Study) work at the Laboratory will be accomplished. This requirement is satisfied by a Laboratory-wide Installation Work Plan (IWP). The IWP presents the Laboratory's overall management and technical approach for meeting the requirements of the HSWA Module, describes the Laboratory's PRSs, and outlines their aggregation into 24 operable units (OUs). The IWP was originally submitted to the EPA on November 19, 1990, and is updated annually, with the most recent update being in November 1992.

All Laboratory OUs are tiered to the IWP and relevant information in the IWP is incorporated by reference. This work plan is in the third set of OU work plans that are necessary to meet the HSWA Module's requirements, as defined in the IWP.

The IWP and the OU 1098 work plan also address radioactive materials and other hazardous substances not subject to RCRA regulation. It is understood that language in this work plan pertaining to subjects outside the scope of RCRA is not enforceable under the RCRA Part B operating permit. However, the policy of the Laboratory and the DOE is to conduct the RFI by taking into account all hazardous materials, whether or not they are regulated by statute.

E.1.4 Location and History of TA-2 and TA-41

The Laboratory's TA-2 and TA-41, both located in Los Alamos Canyon, together occupy 84 acres along the north-central boundary of the Laboratory. Technical Area-2 is located immediately east of TA-41. Industrial areas of the Los Alamos townsite are located on the mesa northwest of TA-2 and TA-41, and TA-61 is located on the mesa to the south. Technical Area-2 is bounded to the east and southeast by TA-21 and TA-53, respectively. Phase I and Phase II investigations conducted at OU 1098 will be carried out to the base of the canyon walls within Los Alamos Canyon. PRSs at OU 1098 are located within Los Alamos Canyon where the elevation decreases to the east from approximately 7000 to 6800 ft. Figure EXEC-1 shows the regional location of the Laboratory and Figure EXEC-2 shows the locations of TA-2 and TA-41 in relation to perimeter properties and to other Laboratory TAs. Figures EXEC-3 and EXEC-4 show site diagrams and the location of PRSs at TA-2 and TA-41, respectively.

Since the establishment of TA-2 in 1943, several types of nuclear reactors have been operated on the site. Technical Area-2 presently is the site of the Omega West Reactor (OWR), an eight-megawatt (MW), water-cooled research nuclear reactor fueled by highly enriched uranium contained in solid fuel elements, the OWR has been in operation since 1956. The two prior reactors consisted of:

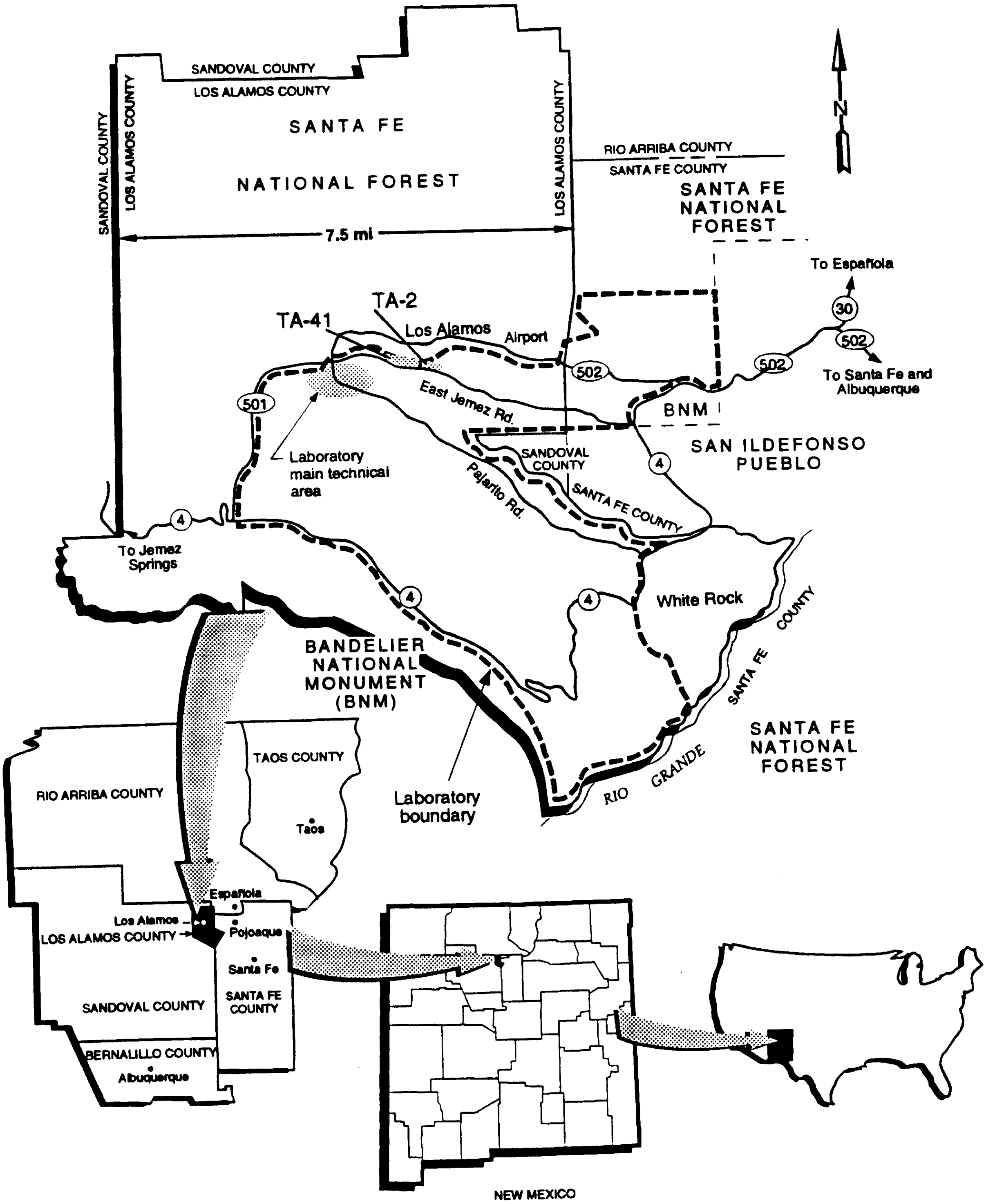


Figure EXEC-1 Regional location of the TA-2 and TA-41 Operable Unit.

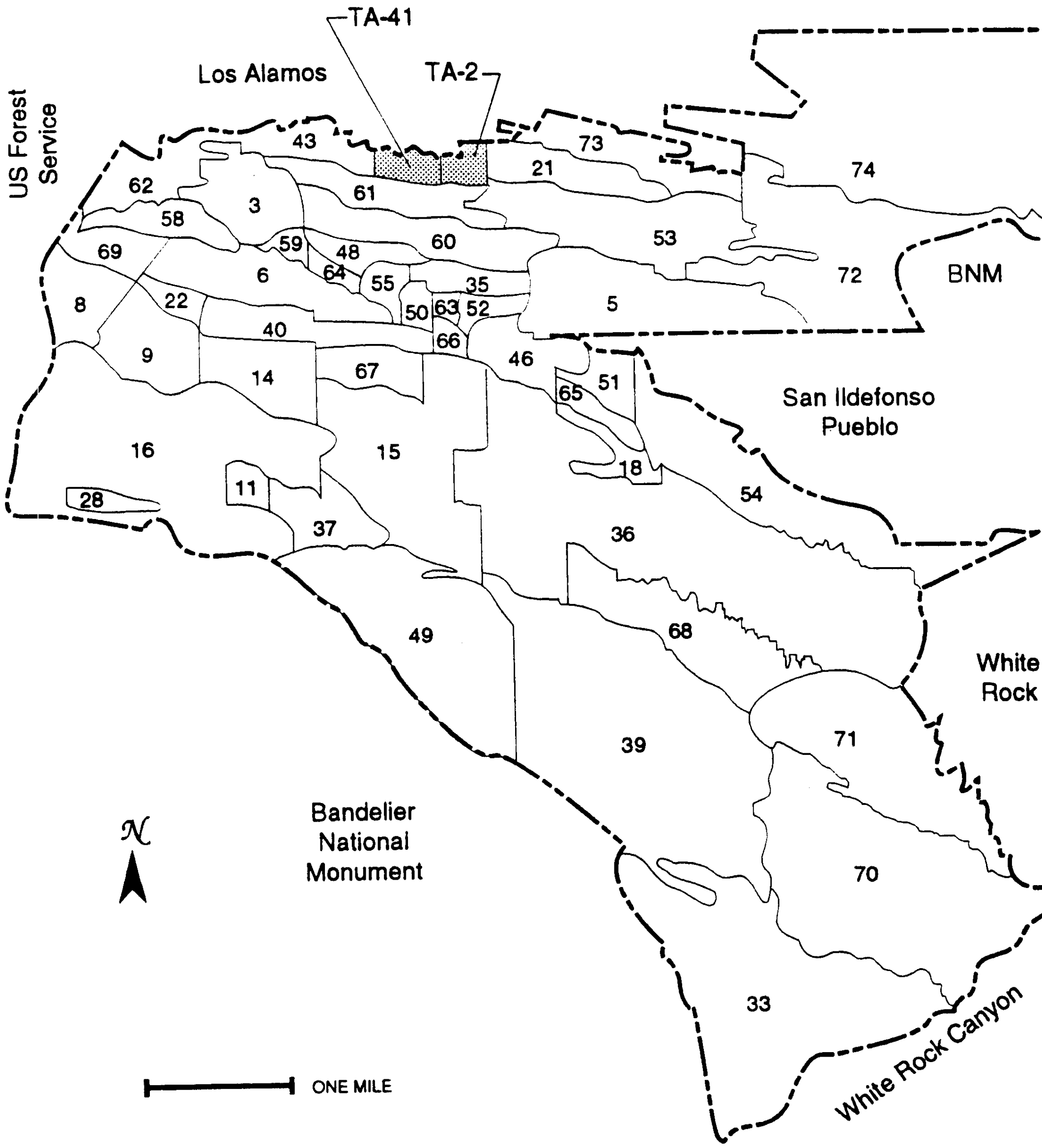


Figure EXEC-2 Locations of TA-2 and TA-41 in relation to other technical areas and landholdings surrounding the laboratory.

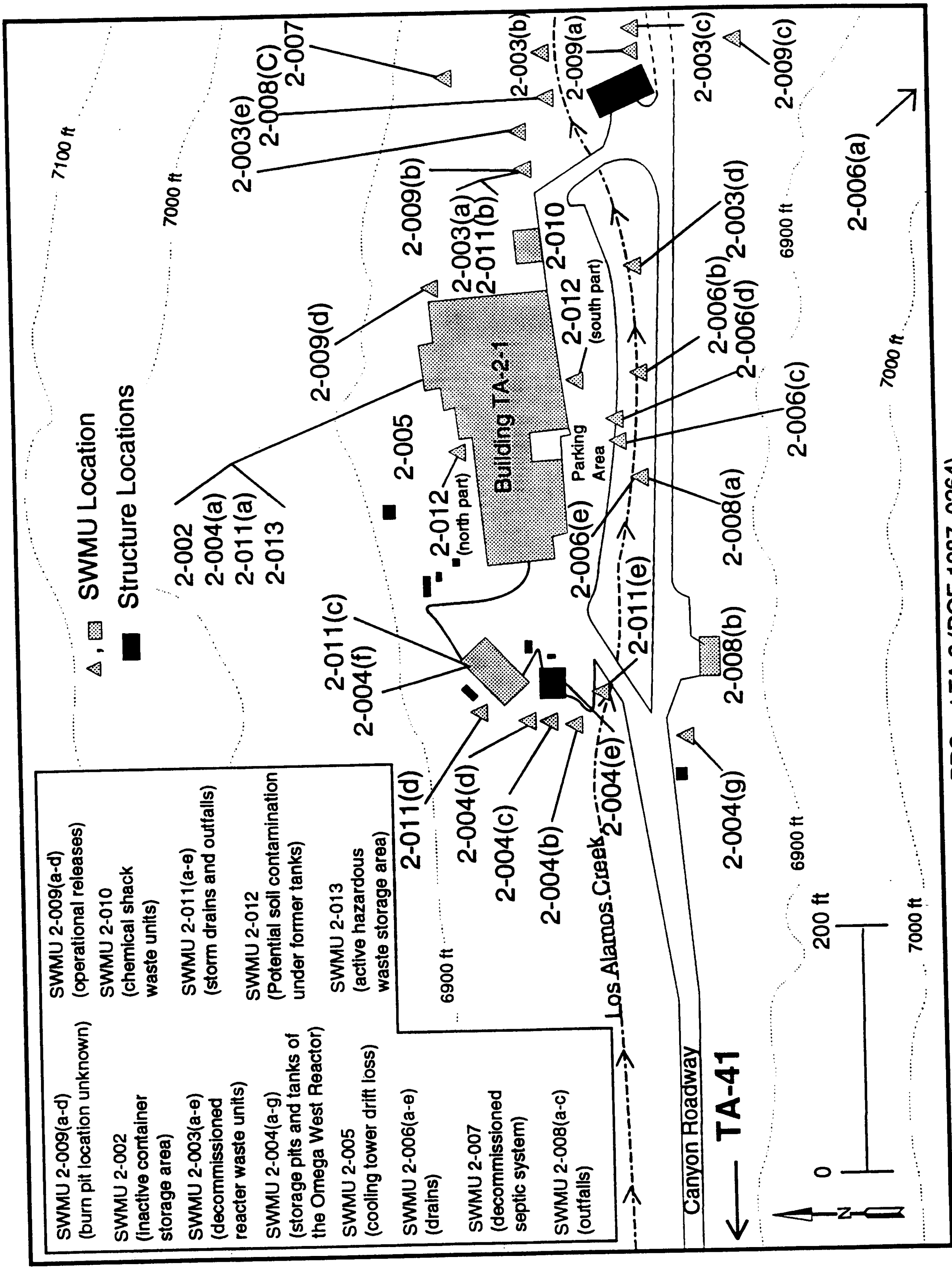


Figure EXEC-3 Location map of all known PRSs at TA-2 (DOE 1987, 0264).

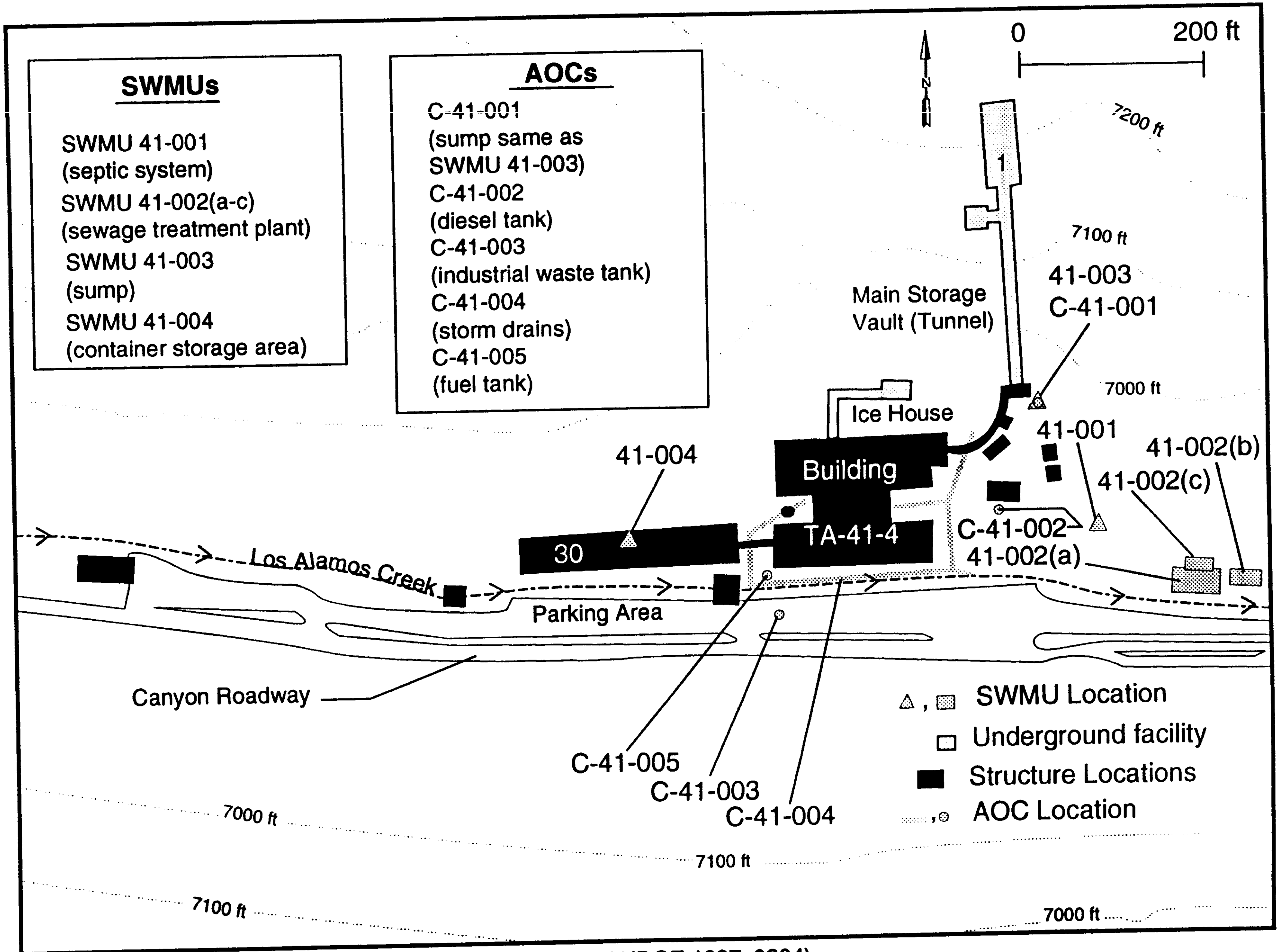


Figure EXEC-4 Location map of all known PRSs at TA-41(DOE 1987, 0264).

1. A decommissioned plutonium-fueled, mercury-cooled reactor. This reactor system was self-contained and operated from 1946 to 1953.
2. The first Water Boiler reactor, which was constructed in 1943 and subsequently underwent systems modifications, until it was decommissioned in 1974.

This Water Boiler, the first homogeneous liquid-fueled reactor, contained enriched uranium-235 dissolved as a uranyl salt in water. Increasingly powerful versions were eventually built and operated from 1944 to 1974. The evolution of hydrogen and oxygen produced by radiolytic decomposition of water gave the appearance of boiling, although the solution never actually reached boiling temperature. In 1951, a gas recombination system was installed to recombine the radiolytic gases. During water boiler reactor operation at 25 KW, approximately 0.25 L/min of excess gas, air, and some fission product gases were expelled through a remote stack utilizing a centrifugal blower at its base.

Releases of tritium resulted from a leak in the primary cooling water system at OWR. The leak occurred from a break in a weld seam in a section of the delay line running from building TA-2-1 to the surge tank. This release was discovered in January 1993 and was within the Guaje Mountain fault zone. Tritium was leaking from the delay line at a rate of up to 70 gallons per day until March 1993 when the cooling water was drained from this line. Typical concentrations of tritium in the cooling water ranged from 15.7×10^6 to 20.2×10^6 pCi/L.

E.1.5 Contaminants and Pathways of Concern

The PRSs identified at OU 1098 fall into several conceptual categories, as follows:

- Surface and near-surface soil and sediment, associated with the TA-2 reactors and TA-41 operations, which may be contaminated above screening action levels with beryllium chromium, fission products, tritium, and other species and may be sources for the observed concentrations of tritium and fission products in alluvial groundwater, and.
- Septic/subsurface disposal and wastewater treatment systems with potential for low-level radionuclide contamination of surface soils, subsurface soils, and sediment.

The developed areas of TA-2 and TA-41 are located within the floor of Los Alamos Canyon and lie approximately 800 ft above the main aquifer within the Santa Fe Group sediments. Prior site characterization confirms that groundwater within the alluvium is present in Los Alamos Canyon only a few feet below land surface. Perched groundwater within the basalt-Puye Formation may be present at approximately 250-300 ft below the canyon bottom.

The Rendija Canyon and Guaje Mountain faults are exposed within TA-41 and TA-2, respectively. These geologically active faults may be a pathway for water to reach the perched and main aquifers, and if so might also be migration conduits for waterborne contaminants present at OU 1098.

Pathways and receptors are of long-term concern because of the site's relatively accessible location and presence of known contaminant transport pathways under current site conditions. Portions of Los Alamos Canyon (excluding TA-2 and areas of TA-41 which would possibly remain under indefinite institutional control) may ultimately revert back to the National Park Service (NPS) or Bandelier National Monument (BNM) for recreational use. Groundwater pathways are of concern due to the shallow depth to alluvial groundwater, occurrence of the Rendija Canyon and Guaje Mountain faults, and the presence of transport mechanisms. Surface water and air pathways are also of concern because the bulk of TA-2 and TA-41 contaminants were discharged to soils and sediments and/or dispersed into the atmosphere. Potential exposure points for receptors within Los Alamos Canyon include springs, seeps, gaining stream reaches, wetland areas, and possibly discharging wells.

Institutional control for possibly 100 years or more is assumed to be the most likely risk assessment scenario for TA-2 and TA-41, based on past activities and releases associated with the different reactors in TA-2 and operations in TA-41. While there is institutional control, human activities that might disturb the site can be controlled, as can natural processes to some degree. However, independent of institutional control, exposure pathways could result from.

- Exposure of buried contaminants through erosion, followed by dissolution/desorption, surface run-off and sediment transport, or aerial resuspension,
- Flooding,
- Site disturbance through human activity,
- Faulting,
- Infiltration through the vadose zone, and
- Transport within groundwater by physical, chemical, and biological vectors.

E.2 Technical Approach

The IWP provides for use of the observational approach to select an eventual remedy in the face of inevitable uncertainties about the site environment. The essence of the observational approach is that the most likely remedial actions eventually to be taken can be selected before full site characterization has been accomplished, and these potential actions can be used to constrain the scope of the field investigation.

This approach accommodates other goals, including the use of screening action levels as criteria for identifying releases and determining the need for corrective measures studies (CMSs). The observational approach also advocates the use of discrete field work phases and a sequential sampling strategy, wherein the results gained from each sample guide the nature and location of subsequent sampling sets.

The IWP also calls for the development of data quality objectives (DQOs) to establish the types, quantity, and quality of data required to meet the objectives of the RFI. This work plan is based on the observational and DQO approaches.

E.2.1 Investigative Strategy

This work plan covers the 84-acre area encompassing TA-2 and TA-41 including approximately 1.0 mi of Los Alamos Canyon. Other portions of Los Alamos Canyon will be investigated from the Los Alamos Canyon Reservoir (three miles west of TA-41) to the Rio Grande during the canyons OU activities.

The Laboratory ER Program may conduct site-wide background studies (Framework Studies) of hydrology, geology, geochemistry, and other topics to support OU-specific investigations. These studies will have general applicability for all OUs. The results of the Baseline Characterization section of this work plan will be evaluated following review of the results of site-wide investigations that focus on general environmental characteristics to provide the context in which the migration potential of contaminants from OU 1098 SWMUs will be evaluated. The balance of the field sampling plan for OU 1098 is directed toward groupings of related PRSs and focuses on contaminant identification and the nature and extent of migration. Investigation groups addressed in specific sections of this work plan are listed below:

- TA-2 SWMUs, and
- TA-41 SWMUs.

For purposes of a preliminary assessment of impact potential to human health, Phase I efforts should be directed toward characterization of the nature, magnitude, and extent of the presence of appropriate RCRA Appendix VIII chemical substances and radionuclides within OU 1098 and the first major depositional area east of TA-2. The results of Phase I sampling will be compared with screening action levels, included in the IWP, that conservatively represent risk potential to humans. Baseline risk assessment of ecological impact potential within Los Alamos Canyon requires an evaluation of the environmental media affected. The media that are important in assessing risk potential posed to wildlife include soil, surface water, and sediment. These investigations will be carried out at a later date using a phased approach.

To the extent possible, this work plan also has been tailored to integrate with the Laboratory's routine environmental surveillance program, with RFIs of adjoining TAs (TA-1, TA-21, TA-43, and TA-53) within and adjacent to the entire 8.5 mi. length of Los Alamos Canyon, and with the canyons RFI covering Los Alamos Canyon outside of OU 1098. Because the vast majority of contaminants are located at and near TA-2, the emphasis of the work plan is on this investigation group.

E.2.2 Analytical Strategy

Tritium, cesium-137, strontium-90, uranium, and plutonium, as well as chromium and mercury, are the most significant constituents at TA-2 and TA-41 and thus are the primary focus of PRS-specific investigations. These analytes are considered of primary concern either because of their measured significant presence in alluvial groundwater or because of the nature of their use as in the case of chromium and mercury. Sampling plans take possible contaminant distributions into account to maximize the effectiveness of this RFI, and include constituents that may be present because of their known use at TA-2 and TA-41.

Field radiological and chemical screening will be used to initially identify contaminated areas. In addition, extensive use of radiological area surveys is proposed to detect any radioactively contaminated areas.

Field laboratory analyses can be used to provide rapid quantitative data to guide field operations. An on-site mobile laboratory and off-site laboratories will be used, as appropriate, to provide high-quality analytical data and to verify field screening and field surveys.

E.2.3 Scope

The RFI field work described herein is expected to require about three years to complete, the length of time being contingent upon the availability of funding. Two years of Phase I field work is expected to be sufficient to complete the RFI for most PRSs, but a second phase will be executed if field results warrant. For TA-2, a Phase II investigation of one year duration probably will be necessary.

A summary of the scope of the investigations is given in Table EXEC-1, which lists the sections of the work plan in which investigations are described. Table EXEC-2 and Figure EXEC-5 summarize the schedule for the planned field investigations and reports.

E.3 Reports

HSWA Module VIII specifies the submission of periodic reports, including programmatic status reports and phase reports. Execution of this RFI will provide data for these reports (Table EXEC-2). At the conclusion of the RFI, a comprehensive report will be prepared that summarizes the entire RFI.

Reports generated during this RFI will be made available for review by the public at the ER Community Reading Room in Los Alamos, New Mexico. The Reading Room is open to the public from 9:00 a.m. to 4:00 p.m. Monday through Friday, excluding Laboratory holidays. The final RFI report, as well as periodic progress reports, also will be made available.

TABLE EXEC-1
SUMMARY OF THE SCOPE OF THE OU 1098 RFI

Phase I Investigations

	Number of Discrete Samples							
Chapter/ Section	Surface Soil/Sediment Samples	Sump, Dry Well, Catch Basin, Septic	Subsurface Core Samples[e]	Surface Water Samples[b]	Ground-water Samples[b]	Number of QA/QC Samples[c]	Number of Boreholes Drilled (Borehole Length in ft)	Radiological Screening Area (ft^2)
7.2 Baseline	82[a]	---	--- ---	20	24	20[d] 3	5 (15) Shallow 1 (250–300) Intermediate	(f)
7.4 SWMU 2-003	18	---	6	---	---	3	2 (15)	5300
7.5 SWMU 2-004	6	---	24	---	---	3	8 (15)	112,000
7.6 SWMU 2-005	12	---	0	---	---	3	0	0
7.7 SWMU 2-006	2	4	6	---	---	6	2 (15)	500
7.8 SWMU 2-007	2	---	3	---	---	3	1 (15)	1750
7.9 SWMU 2-008	3	---	9	---	--	3	3 (15)	7400
7.10 SWMU 2-009	25	---	36	---	---	9	12 (15)	5250
7.11 SWMU 2-010	0	---	0	---	---	0	0	0
7.12 SWMU 2-011	4	8	12	---	---	6	4 (15)	1200
7.13 SWMU 2-012	0	---	6	---	---	3	2 (15)	0
7.14 SWMU 41-001	0	---	6	---	---	3	2 (15)	2200
7.15 SWMU 41-002	13	---	15	---	---	9	5 (15)	14,100
7.16 SWMU 41-003	6	---	0	---	---	3	0	3300
7.17 AOC C 41-004	1	14	3	---	---	6	1 (15)	250
TOTAL	174	26	126	20	24	111	48	153,250

[a] Number of baseline surface soil/sediment samples. The 22 surface samples plus 15 sediment transect samples which will be taken quarterly for one year for a total of 60 transect samples.

[b] Surface water samples will be taken from five locations in the creek, quarterly for one year, for a total of 20 samples. Groundwater samples will be taken from six locations, quarterly for one year, for a total of 24 samples.

[c] Column list includes only QA/QC samples for soil/sediment and core samples. Total includes an additional 32 QA/QC samples needed for surface and groundwater samples.

[d] Number of baseline characterization QA/QC surface soil/sediment samples includes 4 QA/QC samples to be collected at each quarterly sediment transect sample collection, for a total of 16 QA/QCA samples per year.

[e] Values in this column assume three subsurface core samples per 15 ft borehole at PRSs. The number of core samples per baseline characterization borehole is variable.

[f] Area to be determined. See Section 7.2.4.1 for details.

TABLE EXEC-2

SCHEDULE OF PHASE I FIELD WORK (FY 94, AND FY 95) AND TECHNICAL MEMORANDA/ WORK PLAN MODIFICATION REPORTS FOR THE TA-2 and TA- 41 RFI

Results of RFI field work will be presented in three principle documents: quarterly technical progress reports, phase reports/work plan modifications, and the RFI Report. The schedule below summarizes the future documents associated with implementation of this OU work plan that are deliverable to EPA and DOE.

Document	EPA	DOE	Date Due
Monthly	X	X	25th of the following month
Quarterly	X		Feb. 15, May 15, Aug. 15
Annual	X	X	Nov. 15
Phase Reports	X	X	As in baseline; DOE milestones

Chapter and Section		Phase I Field Work	RFI Report Publication Dates: Draft	RFI Report Publication Dates: Final
7.1	Baseline Characterization	Oct. 1, 1993 –Sept. 29, 1994	Mar. 1, 1995	Sept. 30, 1995
7.4-7.13	TA-2	Oct. 1, 1993 – Sept. 29, 1995		
7.14 7.16	TA-41	Oct. 1, 1993 – Sept. 29, 1995		

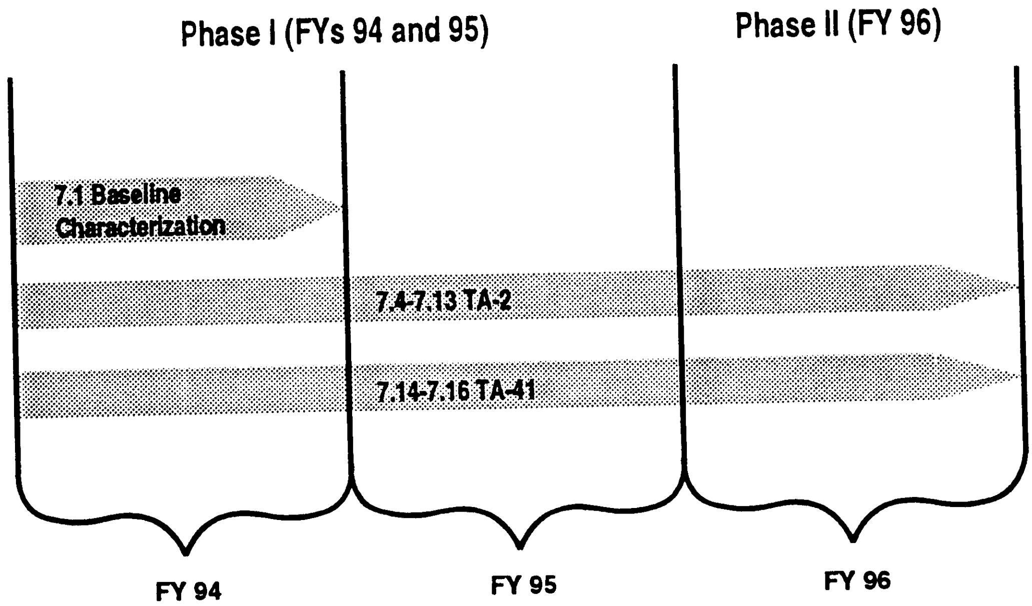


Figure EXEC-5. TA-2 and TA-41 RFI schedule proposed in this OU work plan.

TABLE EXEC-3
ESTIMATED COSTS OF BASELINE ACTIVITIES AT OU 1098

Task	Budget*	Scheduled Start	Scheduled Finish
RFI Work Plan	994	1 Oct 91	10 Aug 93
RFI Field Work	4472	20 Aug 93	15 Dec 95
RFI Report	1645	12 Sep 94	23 Apr 97
CMS Plan	855	23 Jan 97	12 Dec 97
CMS Work	1119	1 Oct 92	11 Dec 98
CMS Report	668	14 Dec 98	7 Oct 99
ADS Management (Assessment and Remediation)	1012	1 Oct 91	30 Sep 99
Voluntary Corrective Action	574	1 Mar 93	30 Sep 97
Total	11339		

* in thousands

E.4 Phase Reports/Work Plan Modifications

Because of the time required to complete the field work, interim reports will be generated and submitted as phases of work on OU 1098 are completed. These phase reports will serve both to summarize results to date and will provide the additional Phase I or Phase II sampling plans that might be required (including revisions of initial field sampling plans). Phase reports/work plan modifications may be submitted for work conducted on individual PRSs or aggregates of PRSs, as appropriate. A summary of planned submission dates is given in Table EXEC-2 and estimated costs of baseline activities at OU 1098 are provided in Table EXEC-3.

LIST OF ANNEXES

LIST OF APPENDICES

LIST OF TABLES

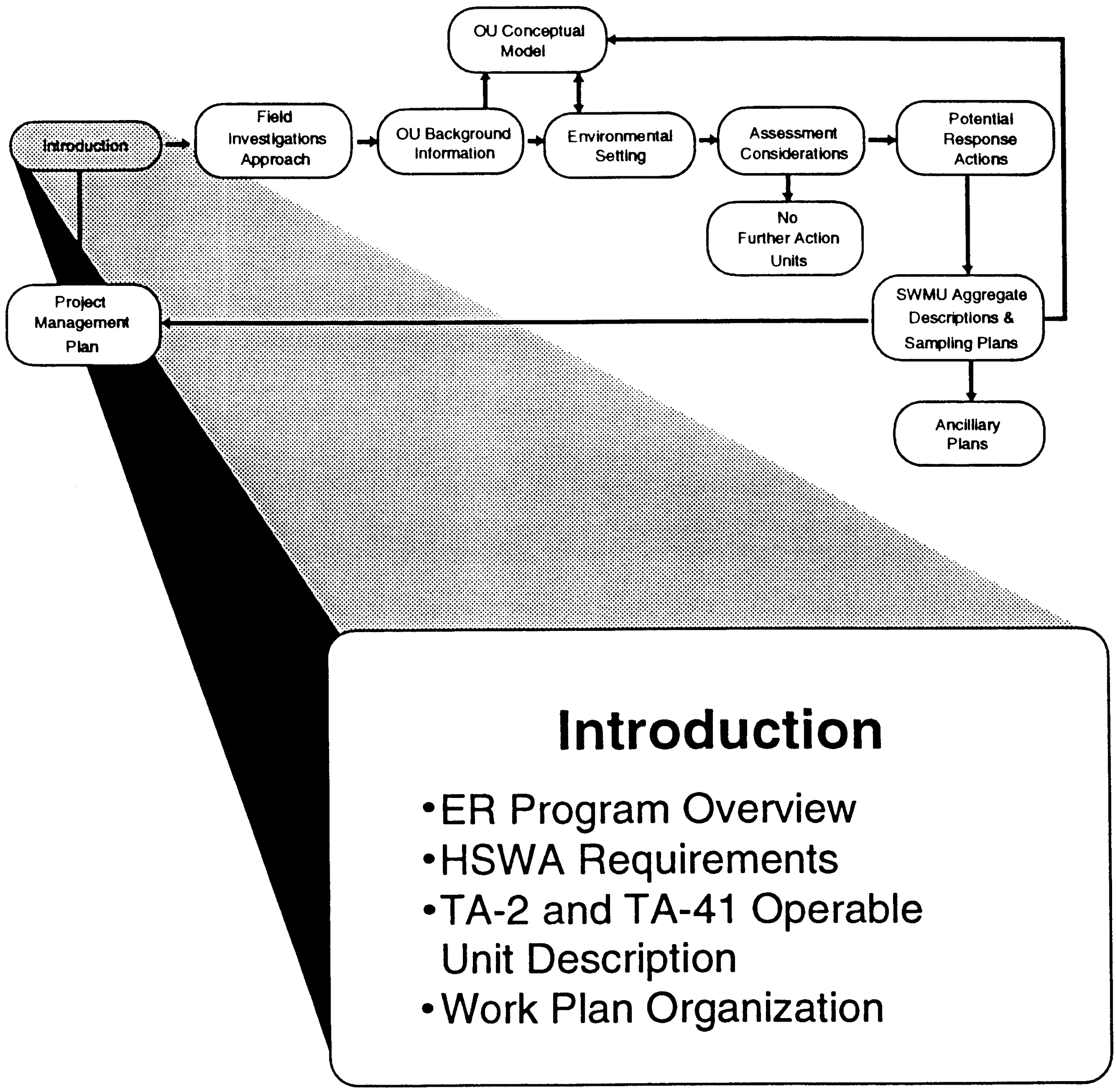
LIST OF FIGURES

OU 1098 ACRONYMS AND ABBREVIATIONS

AA	atomic absorption
ADS	Activity Data Sheet
ALARA	as low as reasonably achievable
AOC	Area of Concern
asl	above sea level
ASTM	American Society for Testing and Materials
BGS	below ground surface
BNM	Bandelier National Monument
CAR	Correction Action Requirement
CEARP	Comprehensive Environmental Assessment and Response Program
CEC	cation exchange capacity
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CDM	Definition to be determined
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CMI	Corrective measures investigation
CMP	corrugated metal pipe
CMS	Corrective Measures Study
COC	contaminant of concern
COE	Corps of Engineers
DCG	derived concentration guide
DOE	Department of Energy
DOT	Department of Transportation
DQO	data quality objective
EM	environmental management
EPA	Environmental Protection Agency
ER	environmental restoration
ESG	Environmental Surveillance Group
FIDLER	field instrument for detection of low-energy radiation
FIMAD	facility for information management analysis and display
FUSRAP	Formerly Utilized Sites Remedial Action Program
GC	gas chromatography
GM	Geiger-Müller
HEPA	high-efficiency particulate air
HNU	instrument for measuring organic vapors
HRS	Hazard Ranking System
H&S	health and safety
HSE	health, safety, and environment
HSWA	Hazardous and Solid Waste Amendment
IA	interim action
ICAP	inductively coupled argon plasma spectroscopy
ICP	inductively coupled plasma
ICPAES	inductively coupled plasma atomic emission spectroscopy
IH	Ice House
IWP	Installation Work Plan
LAMPF	Los Alamos Meson Physics Facility
LANL	Los Alamos National Laboratory

LLW	low-level waste
MDL	minimum detection limit
MS	mass spectrometry
MSV	Main Storage Vault
NEPA	National Environmental Policy Act
NFA	no further action
NMED	New Mexico Environment Department
NMSP	New Mexico state plane
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
NPS	National Park Service
NRC	Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration
OU	operable unit
OVA	organic vapor analyzer (see HNU)
OWR	Omega West Reactor
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCB	polychlorinated biphenyl
PID	photoionization detector
PQL	practical quantification limit
PRS	potential release site
QA	quality assessment
QAPjP	Quality Assurance Project Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RPS	Radiation Protection Standard
SAP	Sampling and Analysis Plan
SEM	scanning electron microscope
SOP	standard operating procedure
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TA	technical area
TAL	target analyte list
TCL	target compound list
TD	total depth
TDS	total dissolved solids
TLD	thermoluminescent dosimetry
TRU	transuranic
TU	tritium unit
UC	University of California
USGS	United States Geological Survey
VCA	voluntary corrective action
VCT	vitrified clay pipe
VOC	volatile organic compound
WBRDP	Water Boiler Reactor Decommissioning Project
XRF	X-ray fluorescence analyzer

Chapter 1



OU Conceptual Model
Introduction
Field Investigations Approach
OU Background Information
Environmental Setting
Assessment Considerations
Potential Response Actions
No Further Action Units
Project Management Plan
SWMU Aggregate Descriptions & Sampling Plans
Ancilliary Plans
Introduction
•ER Program Overview
•HSWA Requirements
•TA-2 and TA-41 Operable Unit Description
•Work Plan Organization

1.0 INTRODUCTION

1.1 Overview of the Environmental Restoration Program

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

The Laboratory's operating permit under the Resource Conservation and Recovery Act (RCRA) sets forth requirements that are implemented by the Laboratory's ER Program. In particular, the Hazardous and Solid Waste Amendments (HSWA) Module VIII and schedules of the Part B RCRA Operating Permit issued by the Environmental Protection Agency (EPA) give specific requirements affecting the conduct of the ER Program (EPA 1990, 0306). The HSWA Module became effective on May 23, 1990 (EPA 1990, 0306). The Laboratory's ER Program also is integrated with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

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

1.2 Hazardous and Solid Waste Amendments Requirements

The HSWA Module also requires the Laboratory to prepare OU work plans for specific investigations. The work plan for OU 1098 is one of 24 OU work plans to be prepared. Two technical areas (TAs) make up OU 1098, TA-2 and TA-41. Within the ER Program, the TA-2 and TA-41 assessment task is identified as AL-LA-42, Activity Data Sheet (ADS) 1098. Additional information regarding the Laboratory's ER Program, its implementation, and the guidance under which the OU 1098 work plan was prepared is given in Chapter 3 of the IWP.

Sites to be investigated and evaluated by the ER Program are collectively referred to as Potential Release Sites (PRSs). A PRS may be a Solid Waste Management Unit (SWMU) or an Area of Concern (AOC). A SWMU is defined by the EPA in the HSWA Module of the Laboratory's RCRA permit as any discernible unit at which solid wastes have been placed at any time, irrespective of whether it was intended for the management of solid or hazardous waste. Such units include any area at or around a facility at which solid wastes have been routinely and systematically released. Some materials are exempt from RCRA's definition of solid waste and are therefore not subject to the provisions of the HSWA Module; however, the ER Program wants to address radioactive as well as other hazardous substances not regulated by RCRA. As a result, sites that contain potentially hazardous materials but no hazardous substances defined by RCRA are included in the RFI process and are called AOCs.

This work plan addresses ten (1.7%) of the 603 SWMUs listed in Table A of the HSWA Module of the Laboratory's Part B RCRA Operating Permit. Of these ten SWMUs, three are contained in the 182 SWMUs appearing on the HSWA Module Table B list of priority SWMUs. SWMUs located at TA-2 and TA-4 listed in Table A of the HSWA Module include: 2-005 (systematic leak due to cooling tower drift loss), 2-007 (decommissioned septic system), 2-008(a) (inactive outfalls), 2-009(a, b, c) (inactive operational releases), 41-001 (inactive septic system), and 41-002(a, b, c) (sewage treatment plant). Priority SWMUs also listed in Table B of the HSWA Module of the Laboratory's Part B RCRA operating permit include: SWMU 2-005, 2-008(a), and 41-001. The TA-2 and TA-41 SWMUs are addressed in this work plan to meet the June 4, 1993, HSWA permit modification. Only the Module VIII SWMUs are presented in this work plan for EPA approval and regulation.

Between 1984 and 1987, the Laboratory was evaluated under the Comprehensive Environmental Assessment and Response Program (CEARP). A major objective of this program was to determine whether past waste disposal practices – practices in effect before full recognition of environmental hazards and passage of extensive environmental legislation – created environmental problems that require remedial action today. During Phase I of CEARP, DOE/UC conducted and documented PA/SI activities specified by CERCLA in the first comprehensive attempt to identify potentially hazardous waste sites at the Laboratory. The results are summarized in the CEARP Phase I report (DOE 1987, 0264). DOE submitted this document to EPA's Region VI in October of 1987 to fulfill the CERCLA 103(c) notification requirement. The CEARP Phase I report was also distributed to the state and to the public.

In early 1987, EPA Region VI performed a RCRA facility assessment (RFA) to identify all potential SWMUs at the Laboratory. Upon receipt of the RFA, DOE/UC prepared a SWMU report (International Technology Corporation 1988, 0329) in an attempt to incorporate additional information in the RFA SWMU list and to correct inaccuracies in the RFA. This report was released in December 1988, and it combined lists from the CEARP Phase I report (DOE 1987, 0264), the RFA, and internal records searches and interviews. The report identified approximately 1,100 PRSs. The EPA selected the 603 SWMUs identified in the HSWA Module from this report, based on the agency's preliminary assessment of the potential impact to human health and safety.

The November 1990 Laboratory SWMU report (LANL 1990b, 0145) and Appendix F of the IWP (LANL 1992, 0768) list a total of 17 SWMUs within the boundaries of OU 1098, where 13 TA-2 SWMUs are subdivided into 36 SWMU subunits, and four TA-41 SWMUs, one of which is divided into three SWMU subunits. Five AOCs are listed for TA-41. These are a sump (which is the same as SWMU 41-003), a diesel tank, an industrial waste tank (which may never have existed), storm drains, and a fuel tank with unknown location. No new SWMUs or AOCs are proposed in the TA-2 and TA-41 work plan for inclusion on a revised PRS list. Table 1.2-1 summarizes the designations and alternative identification schemes for the 13 TA-2 SWMUs, four TA-41 SWMUs, and five TA-41 AOCs. This table also identifies logical SWMU groupings and the work plan section in which each SWMU is addressed.

Section 3.4.4 of the IWP (LANL 1992, 0768) states that each OU work plan may propose a HSWA Module Class II permit modification to adjust the SWMUs listed in Table A of the HSWA Module. Such adjustments may be made to remove SWMUs that have been determined to need no further investigation. There are four SWMUs, 2-001, 2-002, 2-013 and 41-004, in OU 1098 that, based on historical evidence, do not appear to qualify as SWMUs. The detailed bases for the recommendation to delete these SWMUs are given in Chapter 8.

Because this RFI is scheduled to take approximately three years to complete, with completion being contingent on the availability of funding, the Laboratory proposes to submit phase reports on site characterization activities on TA-2 and TA-41 PRSs to update the EPA and other interested parties on RFI field work progress. As needed, these phase reports may also serve as work plan modifications to revise field sampling plans, as appropriate, and to reflect initial characterization results. Therefore, they are essentially partial RFI Phase I report and partial RFI Phase II work plan. The schedule for these phase reports is presented in Table EXEC-2 and Annex I (Project Management Plan) of this OU work plan.

1.3 Description of Operable Unit 1098 and Solid Waste Management Units

Activities ranging from the mid-1940s to the present include use of TA-2 to site a series of research reactors and of TA-41 to provide support weapon development and long-term studies on weapon subsystems. Other areas of Los Alamos Canyon, from OU 1098 to the Rio Grande, will also be investigated as part of other Laboratory RFIs work plans. Figure EXEC-1 shows the regional location of the Laboratory, and Figure EXEC-2 shows the locations of TA-2 and TA-41 with respect to other Laboratory TAs and perimeter properties surrounding the Laboratory. Technical Areas 2 and 41 are located at the north-central boundary of the Laboratory within Los Alamos Canyon. Figures EXEC-3 and EXEC-4 identify the location of PRSs and other salient site features at TA-2 and TA-41, respectively. Technical Area-2 occupies approximately 41 acres, whereas TA-41 occupies 43 acres. Technical Area-2 is located immediately east of TA-41. Technical Area-2 and TA-41 are located south of the Los Alamos town site, and TA-61 is located on the mesa south of TA-2 and TA-41. Technical Area-2 is bounded to the east and southeast by TA-21 and TA-53, respectively. Appendix A contains a topographic map of the entire Los Alamos Canyon including TA-2 and TA-41. Appendix B contains site maps and drawings and other engineering details relevant to this RFI. Details of the Los Alamos Canyon environment, past use, and release sites in OU 1098 are given in Chapters 3–8 and in Appendix D.

TABLE 1.2-1
PRS INVESTIGATION GROUPS AND DESIGNATIONS

Investigation Group	Work Plan Section	List	SWMU Location	RFA* Description	CEARP* Unit	ER Release ID Number
TA-2	8	2-001†	TA-2	Burn Site	2-001	TA2-7-CA-I-HW/RW
	8	2-002†	TA-2	Inactive container storage	2-002	TA2-8-CA-I-HW/RW
	7.4	2-003(a)	TA-2	Decommissioned reactor Waste units	2-003(a)	TA2-1-CA-A/I-HW/RW TA2-2-CA/A/UST-A/I-HW/RW
	7.4	2-003(b)	TA-2	Decommissioned reactor Waste units	2-003(b)	TA2-2-CA/A/UST-A/I-HW/RW
	7.4	2-003(c)	TA-2	Decommissioned reactor Waste units	2-003(c)	TA2-2-CA/A/UST-A/I-HW/RW
	7.4	2-003(d)	TA-2	Decommissioned reactor Waste units	2-003(d)	TA2-2-CA/A/UST-A/I-HW/RW
	7.4	2-003(e)	TA-2	Decommissioned reactor Waste units	2-003(e)	TA2-2-CA/A/UST-A/I-HW/RW
	7.5	2-004(a)	TA-2	Storage pits and tanks unit	2-004(a)	TA2-1-CA-A/I-HW/RW
	7.5	2-004(b)	TA-2	Storage pits and tanks unit	2-004(b)	TA2-2-CA/S/UST-A/I-HW/RW
	7.5	2-004(c)	TA-2	Storage pits and tanks unit	2-004(c)	TA2-2-CA/S/UST-A/I-HW/RW
	7.5	2-004(d)	TA-2	Storage pits and tanks unit	2-004(d)	TA2-2-CA/S/UST-A/I-HW/RW
	7.5	2-004(e)	TA-2	Storage pits and tanks unit	2-004(e)	TA2-2-CA/S/UST-A/I-HW/RW
	7.5	2-004(f)	TA-2	Storage pits and tanks unit	2-004(f)	TA2-2-CA/S/UST-A/I-HW/RW
	7.5	2-004(g)	TA-2	Storage pits and tanks unit	2-004(g)	TA2-2-CA/S/UST-A/I-HW/RW
	7.6	2-005	TA-2	Cooling tower drift loss	2-005	TA2-5-CA-I-HW
	7.7	2-006(a)	TA-2	Drains	2-006(a)	TA2-1-CA-A/I-HW/RW
	7.7	2-006(b)	TA-2	Drains	2-006(b)	TA2-1-CA-A/I-HW/RW
	7.7	2-006(c)	TA-2	Drains	2-006(c)	TA2-1-CA-A/I-HW/RW
	7.7	2-006(d)	TA-2	Drains	2-006(d)	TA2-1-CA-A/I-HW/RW
	7.7	2-006(e)	TA-2	Drains	2-006(e)	TA2-1-CA-A/I-HW/RW
	7.8	2-007	TA-2	Decommissioned septic system	2-007	TA2-4-CA/ST-I-HW/RW
	7.9	2-008(a)	TA-2	Outfalls	2-008(a)	TA2-3-CA/O-A/I-HW/RW

TABLE 1.2-1
PRS INVESTIGATION GROUPS AND DESIGNATIONS (*continued*)

Investigation Group	Work Plan Section	List	SWMU Location	RFA Description	CEARP Unit	ER Release I.D. Number
TA-2	7.9	2-008(b)	TA-2	Outfalls	2-008(b)	TA2-3-CA/O-A/I-HW/RW
	7.9	2-008(c)	TA-2	Outfalls	2-008(c)	TA2-3-CA/O-A/I-HW/RW
	7.10	2-009(a)	TA-2	Operational releases	2-009(a)	TA2-2-CA/S/UST-A/I-HW/RW
	7.10	2-009(b)	TA-2	Operational releases	2-009(b)	TA2-2-CA/S/UST-A/I-HW/RW
	7.10	2-009(c)	TA-2	Operational releases	2-009(c)	TA2-2-CA/S/UST-A/I-HW/RW
	7.10	2-009(d)	TA-2	Operational releases	2-009(d)	TA2-2-CA/S/UST-A/I-HW/RW
	7.11	2-010	TA-2	Chemical stack waste units	2-010	TA2-1-CA-A/I-HW/RW TA2-2-CA/S/UST-A/I-HW/RW
	7.12	2-011(a)	TA-2	Storm drains and outfalls	2-011(a)	TA2-2-CA/S/UST-A/I-HW/RW TA2-3-CA/O-A/I-HW/RW
	7.12	2-011(b)	TA-2	Storm drains and outfalls	2-011(b)	TA2-3-CA/O-A/I-HW/RW
	7.12	2-011(c)	TA-2	Storm drains and outfalls	2-011(c)	TA2-3-CA/O-A/I-HW/RW
	7.12	2-011(d)	TA-2	Storm drains and outfalls	2-011(d)	TA2-3-CA/O-A/I-HW/RW
	7.12	2-011(e)	TA-2	Storm drains and outfalls	2-011(e)	TA2-3-CA/O-A/I-HW/RW
	7.13	2-012	TA-2	Potential soil contamination Under former tanks	2-012	TA2-6-UST-A/I-PP
	8.4	2-013†	TA-2	Active hazardous waste Container storage areas	2-013	No number
TA-41	7.14	41-001	TA-41	Septic system	41-001	TA41-2-ST-I-RW
	7.15	41-002(a)	TA-41	Sewage treatment plant	41-002(a)	TA41-3-CA/O-I/A-HW/RW
	7.15	41-002(b)	TA-41	Sewage treatment plant	41-002(b)	TA41-3-CA/O-I/A-HW/RW
	7.15	41-002(c)	TA-41	Sewage treatment plant	41-002(c)	TA41-3-CA/O-I/A-HW/RW
	7.16	41-003	TA-41	Sump	41-003	TA41-4-UST/S-A-RW
	8.5	41-004†	TA-41	Container storage area	41-004	No number
	8.6	C-41-001†	TA-41	Sump		
	8.6	C-41-002†	TA-41	Diesel tank		
	8.6	C-41-003†	TA-41	Industrial waste tank		
	7.17	C-41-004	TA-41	Storm drains		
	8.6	C-41-005†	TA-41	Fuel tank		

*RFA, RCRA Facility Assessment; CEARP, Comprehensive Environmental Assessment and Response Program

†No further action proposed (Chapter 8).

Since the establishment of TA-2 in 1943, several types of nuclear reactors have been operated on the site. Technical Area-2 presently is the site of the Omega West Reactor (OWR), an 8-MW, water-cooled, research nuclear reactor fueled by highly enriched uranium contained in solid fuel elements. Prior reactors consisted of: a decommissioned plutonium-fueled, mercury-cooled reactor, which was self-contained and operated from 1946 to 1953; and the first water boiler reactor which was constructed in 1943 and subsequently underwent systems modifications. This Water Boiler, the first homogeneous liquid-fueled reactor, contained enriched uranium-235 dissolved as a uranyl salt in water (Bunker 1983, 14-0012). Increasingly powerful versions were eventually built and operated from 1944 to 1974. The evolution of hydrogen and oxygen produced by radiolytic decomposition of water gave the appearance of boiling, although the solution never actually reached boiling temperature. In 1951, a gas recombination system was installed to recombine the radiolytic gases. During reactor operation at 25 KW, approximately 0.25 L/min of excess gas and air, including some fission product gases, were expelled through a remote stack, utilizing a centrifugal blower at its base (Elder and Knoell 1986, 14-0014).

Thirteen PRSs (SWMUs) have been identified at TA-2 and aggregated as part of this OU. Technical Area-2 contains PRSs comprising: an underground diesel fuel tank, decommissioned reactor waste units, storage pits and tanks, cooling tower drift loss, waste lines, drains, decommissioned septic system, outfalls, operational releases, and chemical shack waste units. Primary materials used or stored at TA-2 consist of uranium, tritium, technetium, plutonium, chromium, cesium, strontium, mercury, acids, solvents, and polychlorinated biphenyls (PCBs).

Technical Area-41 has for many years been used in developing weapon subsystems and long-term studies on weapon subsystems, and such uses continue. There are also offices and shop facilities at TA-41. Four SWMUs and five AOCs have been identified at TA-41. The SWMUs include: a septic system, a sewage treatment plant, a sump, and a container storage area. The five AOCs include a sump, a diesel tank, an industrial waste tank, storm drains, and a fuel tank. Materials of concern that have been used or stored at TA-41 include uranium, plutonium, tritium, lithium, mercury, beryllium, lead, cadmium, explosives, toxic gases, organic chemicals, and thermite-type heat generators.

Technical Area-2 and TA-41 SWMUs are listed in Table 1.2-1. This table also identifies the work plan section in which each SWMU is specifically addressed.

1.4 Work Plan Organization

The purpose of the TA-2 and TA-41 work plan is twofold: to satisfy the regulatory requirements of the HSWA Module VIII and to serve as the detailed field sampling plan for personnel who will implement the RFI characterization activities discussed herein. The HSWA Module sets out the general scope of the work plan, establishes the expected correspondence between the RFI tasks identified in EPA guidance documents (EPA 1989, 0088) and the equivalent ER Program tasks, and specifies the requirements to be fulfilled, as outlined in the IWP and the OU work plans. These considerations are summarized in Table 1.4-1, which has been adapted from the HSWA Module.

TABLE 1.4-1
RFI GUIDANCE FROM THE LABORATORY'S RCRA PART B PERMIT AND CORRESPONDING PORTIONS OF THE TA-2 AND TA-41 RFI WORK PLAN

Scope of the RFI	ER Program Equivalent		
RCRA Facility Investigation Specified Tasks:	LANL Installation Work Plan (IWP)	LANL Task/Site RI/FS	Corresponding Portions of the TA-2 and TA-41 Work Plan
Task I: Description of Current Conditions A. **Facility Background** B. **Nature and Extent of Contamination**	I. LANL Installation Remedial **Investigation/Facility Study Work Plan** A. **Installation Background** B. **Tabular Summary of Contamination by Site**	I. Task/Site Conditions A. Task/Site Background B. Nature and Extent of Contamination	I. A. Chapters 3 and 4 B. Chapters, 5, 6 and 7
Task II: RFI Work Plan A. Data Collection QA Plan B. Data Management Plan C. Community Relations Plan	II. LANL Installation RI/FS Work Plan A. **General Standard Operating Procedure for Sampling, Analysis, and QA** B. **Technical Data Management Program** C. **Health and Safety Program** D. **Community Relations Program**	II. LANL Task/Site RI/FS Documents A. QA Project Plan and Field Sampling Plan B. Technical Data Management Plan C. Health and Safety Plan D. Community Relations Plan	II. A. Annex II and Chapters 6 and 7 B. Annex IV C. Annex III D. Annex V
Task III: Facility Investigation A. **Environmental Setting** B. **Source Characterization** C. **Contamination Characterization** D. **Potential Receptor Identification**	III.	III. Task/Site Investigation A. Environmental Setting B. Source Characterization C. Contamination Characterization D. Potential Receptor Identification	III. A. Chapter 4 B. Chapters, 5, 6 and 7 C. Chapters, 5, 6 and 7 D. Chapter 5
Task IV: Investigative Analysis A. **Data Analysis** B. **Protection Standards**	IV.	IV. LANL Task/Site Investigative Analysis A. Data Analysis B. Protection Standards	IV. A. IWP B. IWP
Task V: Reports A. **Preliminary and Work Plan** B. **Progress** C. **Draft and Final**	V. Reports A. **LANL Installation RI/FS Work Plan** B. **Annual Update of LANL Installation RI/FS Work Plan** C. **Draft and Final**	V. LANL Task/Site Reports A. QA Project Plan, Field Sampling Plan, Technical Data Management Plan, Health and Safety Plan, Community Relations Plan B. LANL Task/Site RI/FS Documents and LANL Monthly Management Status Report C. Draft and Final	V. A. Annexes I—V B. Chapter 1; Annex I C. Chapter 1; Annex I

The generic requirements for preparing RFI work plans can be found in proposed Subpart S regulations. The specific requirements are described in detail in the HSWA Module, and EPA has provided specific guidance in Volume I of the interim final RFI guidance. The IWP provides the framework for the preparation of individual work plans. Each RFI work plan must include a description of overall approach, technical and analytical approaches and methods, quality assurance (QA) procedures, and data management procedures. The HSWA Module also specifically requires the concurrent development of five project-specific management plans. However, the HSWA Module allows the Laboratory to deviate from the specific guidance if the RFI work plan still covers the essential elements discussed above.

To facilitate compliance with the detailed guidance found in Section 2, Volume I, of the EPA's RFI guidance document to the extent practicable while complying with the HSWA Module's requirements, the ER Program has developed a standard outline for RFI work plans. The outline is intended to provide flexibility in work plan preparation while incorporating the information required by the HSWA Module. This outline has been modified to accommodate the site-specific aspects of OU 1098, but the RFI work plan complies with RFI guidance, permit requirements, and regulatory requirements, as well as the substantive requirements of CERCLA.

The EPA defines five general tasks within the RFI process (EPA 1989, 0088; EPA 1990, 0306). These tasks are described below, with reference to the specific chapter(s) of this work plan that addresses each task.

- ***RFI Task I, Description of Current Conditions.*** This task consists of a presentation of facility background information and a general discussion of the nature and extent of contamination. General historical background information on TA-2 and TA-41 is presented in Chapters 3, 4, and 5. PRS-specific information is contained in Chapters 7 and 8.
- ***RFI Task II, RFI Work Plan.*** This task requires plans for project management, quality assurance (QA), data management, health and safety, and community relations. These plans are presented in Annexes I–V.
- ***RFI Task III, Facility Investigation.*** This task sets out requirements for further environmental characterization of the site. The environmental setting is described in Chapter 4 and known data on the nature and extent of contamination at individual PRSs are presented with the field investigation objectives and sampling plans in Chapter 7. Pathway and assessment considerations are discussed in Chapter 5. PRSs proposed for no further action (NFA) are addressed in Chapter 8.
- ***RFI Task IV, Investigative Analysis.*** This task addresses data analysis and protection standards and is addressed in the IWP.
- ***RFI Task V, Reports.*** This task calls for preliminary, work plan, progress, draft, and final reports. As outlined in the IWP, Laboratory work plans are provided on an installation-wide basis and for specific ER Program activities such as this RFI.

The site-specific OU 1098 work plan has been prepared in accordance with this requirement. Table EXEC-2 and Annex I (Project Management Plan) of this OU work plan give schedules for the reports. Periodic reports for the entire ER Program, as well as draft and final RFI reports, will be submitted as described in the IWP.

CHAPTER 1 REFERENCES

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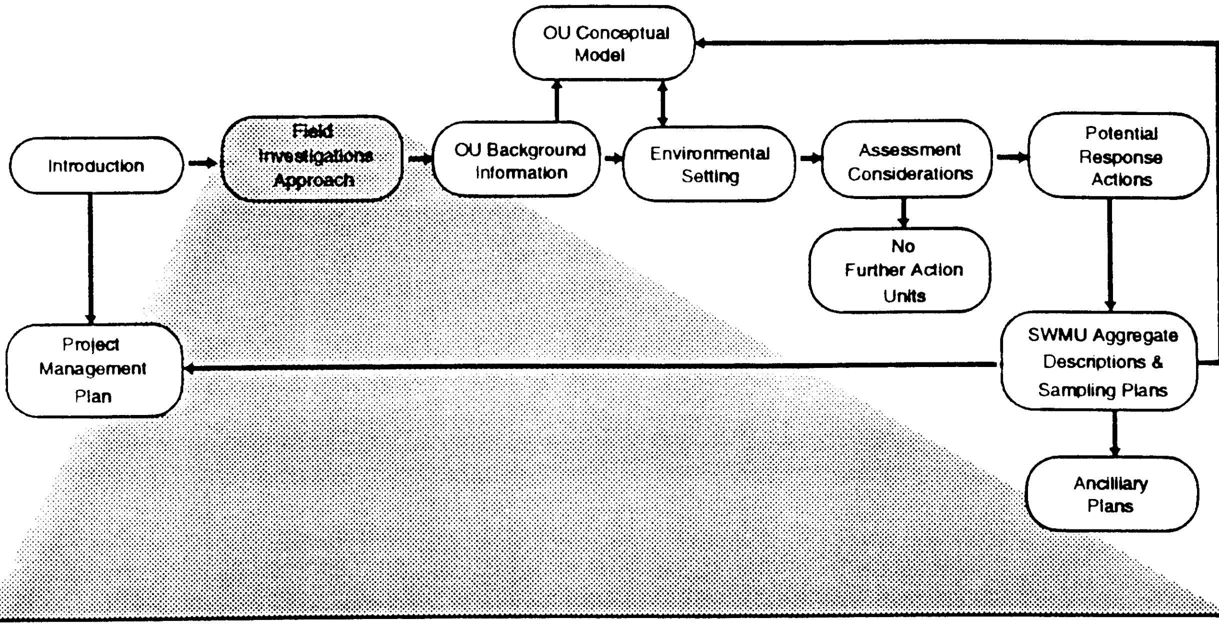
Chapter 2



Approach to RCRA Field Investigations

- Framework Studies
- Observational Approach
- Data Quality Objectives
- Decision Analysis
- Cost - Effectiveness
- Individual SWMUs
- Technical Approach
- Technical Objectives
- Integration with CERCLA, NEPA, and DOE Orders
- Natural Resource Damage Assessment
- Voluntary Corrective Actions
- Conditional Remedies
- Modeling
- NFA Units

2.0 APPROACH TO RESOURCE CONSERVATION AND RECOVERY ACT FIELD INVESTIGATIONS

The Installation Work Plan (IWP) (LANL 1992, 0768) specifies the Environmental Restoration (ER) Program's technical and managerial approaches for compliance with the Hazardous and Solid Waste Amendments (HSWA) Module of the Resource Conservation and Recovery Act (RCRA) Part B operating permit (EPA 1990, 0306) and other regulatory obligations. These approaches define the framework within which Operable Unit (OU) 1098 [Technical Area (TA)-2 and TA-41] RCRA Facility Investigation (RFI) work plan must function, as well as general concepts and objectives guiding the field investigation, and are described in this chapter.

2.1 Technical Approach

A goal of the RFI for this OU is to ensure that the environmental impacts associated with past activities, such as previous releases, at TA-2 and TA-41 are investigated in compliance with the Laboratory's RCRA Part B Hazardous and Solid Waste Amendments (HSWA) module permit. To accomplish this goal, the nature and extent of contamination must be identified and source term definition and transport mechanisms must be evaluated. This information is necessary to assess risk to human and environmental receptors along environmental pathways that may lead to potential exposure.

The technical approach used in this OU work plan is designed to meet required site characterization objectives in a cost-effective manner. This approach in Phase I investigation uses a health-risk-based (on humans only) decision-making process (consistent with the IWP and proposed Subpart S to 40 CFR 264) for recommending selected PRSs for no further action (NFA) or for further study of possible remedial actions under any corrective measures study (CMS) that might be required. The Laboratory is conducting an overall ecological risk assessment which will be utilized for decision making regarding final disposition of PRSs.

The basic technical approach for the RFI for this OU is summarized as follows:

- Archival data are gathered from available sources to help define a basic understanding of the processes and events that produced each PRS and the constituents that may be present at each PRS,
- The archival data are evaluated to identify those PRSs for which no potential hazard exists so that the number of sites that must undergo field investigation can be determined,
- The PRSs that require field investigation are assessed on the basis of archival information to determine whether the initial characterization effort will be a limited Phase I or followed by Phase II characterization,

- Phase I field investigations are conducted as needed to determine the presence or absence of any contaminants of concern (COCs) and to supplement existing information on known source terms or site conditions,
- Data gathered during Phase I investigations are used to determine which PRSs require further characterization and which may be recommended for NFA or VCA. For PRSs that require further study, Phase I data are used and modeled to help design Phase II Sampling and Analysis Plans (SAPs). The RFI work plan will be amended, if necessary, after Phase II SAPs have been completed for sites requiring Phase II investigation. Interim phase reports (formerly referred to as technical memoranda) will be submitted once a year as characterization work proceeds,
- Phase II field investigations are conducted where appropriate to fully characterize the nature and extent of contamination and to obtain the data necessary for quantitative assessment of risk posed by COCs,
- Risk assessment is conducted for each PRS after the data needs have been satisfied by the field investigation, and
- An RFI report is compiled that contains the results of field investigations and recommendations for PRSs evaluated by the decision process. PRSs are recommended for CMS when the analytical or risk assessment results exceed predetermined values established during assessment of either human-health or ecological risk. The remaining PRSs, where analytical or risk assessment results do not exceed predetermined values, are recommended for either VCA or NFA. Recommendations of NFA will be supported by criteria that are discussed in the following text and in Chapter 8 of this OU work plan.

2.2 Observational Approach

The observational approach embodies the philosophy that remedial action can, and often should, be initiated without "full" characterization of the nature and extent of contamination [see Appendix G of the IWP (LANL 1992, 0768)]. For many PRSs, concepts for probable remedial action can be formulated before complete characterization information has been collected that define all uncertainties related to unit conditions (EPA 1987, 0086). The goal is to collect only the data that are required to reduce uncertainties to an acceptable level. We may derive clear benefits from focusing on particular remedial actions while still in early stages of the characterization process.

For example, to apply the observational approach to the stabilization-in-place remedial option, data to define the consequences of leaving waste in place is required. For other PRSs, removal will clearly be an appropriate remedial alternative; in which case, full characterization may be effectively accomplished via monitoring during waste removal.

Probable remedial alternatives for this OU are presented in Chapter 6 of this work plan. It is likely that for some PRSs, Phase I of the RFI, prior to conducting ecological or human risk assessment, will demonstrate that NFA is the appropriate remedial decision. At the other extreme lies cooling tower blowdown (TA-2, SWMU no. 2-005), outfalls (TA-2, SWMU no. 2-008), and a sewage treatment plant (TA-41, SWMU no. 41-002), for which the RFI may require two phases over an extended period. Present information on these PRSs indicates that the most likely remedial responses are soil excavation, stabilization, and monitoring. The observational approach has been utilized to design the RFI for this OU to provide the information required to evaluate the appropriateness of likely remedial responses.

2.3 Data Quality Objectives

The data quality objective (DQO) process provides a step-by-step procedure that focuses the objectives of the field investigation and ensures that proposed data collection activities are carefully developed from, and tied back to, decision criteria and strategies. The result is a clear definition of the key characterization and remedial issues and specification of the types, quantity, and quality of data required to achieve RFI objectives. Philosophy and details of the DQO process are given in EPA publications (EPA 1987, 0086).

The DQO process has been embraced in the development of this OU work plan. General DQOs are addressed in Chapter 6 and are developed more specifically for individual PRSs in the relevant sections of Chapters 7 and 8. These portions of the work plan include discussions of DQO logic diagrams, decision points, and decision criteria.

2.4 Decision Analysis

The decision analysis approach, which provides for efficient identification and evaluation of corrective measures alternatives, is described in Appendix I of the IWP (LANL 1992, 0768). This appendix describes how decision analysis will be used in the ER Program. Because the decision analysis process is being developed concurrently with this OU work plan, the process could be applied to this OU during the first year of field work, reflecting the decision-making framework described in the IWP. Future documents describing work at the operable unit will reflect this approach.

2.5 Cost-Effectiveness Analysis

Cost-effectiveness analysis compares the costs of alternative strategies for achieving remedial goals to the cost of the least expensive alternative, if appropriate. Coupled with the observational approach, a cost-effective analysis during the RFI may lead to the decision that further characterization of a PRS would be less cost-effective than proceeding directly to a remedial action. This decision requires an assessment of the uncertainties that would result from incomplete characterization against the probable costs and benefits of additional characterization. This general philosophy has been followed in the development of this RFI work plan.

2.6 Individual Potential Release Sites

Technical Area-2 and TA-41 PRSs have been listed separately because they have different locations and/or known physical characteristics (Table 1.2-1). Each PRS is assigned a section in Chapters 7 and 8, where the relevant field investigation plan is described. The logic for these individual listings and their relationship to the work plan design are discussed in detail in Chapters 7 and 8 of this OU work plan.

2.7 Technical Approach

Chapter 4 of the IWP (LANL 1992, 0768) outlines the technical approach generally employed in the Laboratory's ER Program. Key elements are summarized in this subsection as they pertain to the development of this OU work plan.

2.7.1 Screening Action Levels

The use of screening action levels [defined in the Environmental Protection Agency's (EPA's) proposed Subpart S regulations] as criteria for identifying releases from PRSs and for determining the need for a Corrective Measures Study (CMS) is discussed in the IWP (Section 4.2.2, Screening Action Levels, and Appendix J, Derivation of Screening Action Levels). Subsection 6.1.3 of this OU work plan discusses screening action levels as they relate to TA-2 and TA-41.

2.7.2 Sequential Sampling and Work Plan Phases

Field sampling plans in this work plan are based on sampling concepts discussed in Appendix H of the IWP (LANL 1992, 0768). In general, in sequential sampling, the results from each sample set are used to determine if additional sets are required and to guide the selection of the subsequent sample set. In this iterative process, each incremental set of samples assists in determining the required number of additional samples and their optimal locations.

Sequenced sampling is closely related to the concept of a phased approach to the RFI. Only a single phase of work is expected to be necessary for most TA-2 and TA-41 PRSs, but two phases are planned for some PRSs that probably contain almost all of the site contaminants. Phase I will provide initial information required for detailed planning of the subsequent phase.

2.7.3 Risk Assessment

In general, RFI characterization leads to risk assessment, which, together with decision analysis, is used to determine the need for remedial action. Health-risk-based analyses will be used to set cleanup levels at Laboratory PRSs. This RFI is designed to provide data for both radiological and nonradiological risk assessment following the RFI at individual PRSs and over the entire OU. Baseline risk assessment scenarios and criteria that are presented in the 1992 version of the IWP are currently being developed for the ER Program.

2.7.4 Integration with Other Laboratory Activities

To the maximum practical extent, this RFI work plan has been integrated with other Laboratory-wide environmental activities. In particular, the ER Framework Studies Program and the Laboratory's Environmental Surveillance Program have activities that overlap with this RFI work plan. This RFI will also be integrated with work plans for TA-1, TA-21, TA-43, and TA-53, and for work plans to be developed later for canyons assessment. Specific examples of integrated activities are deep characterization borehole placement and other subsurface characterization. Data needs for this RFI that overlap with other environmental activities of this nature are identified as appropriate.

RCRA Facility Investigation coordination with non-ER operations at TA-2 and TA-41 is also required. Because both current and planned use of TA-2 and TA-41 for on-site Laboratory operations is ongoing and the activities generally are located near PRSs, the RFI may affect non-ER site activities. Consequently, the RFI will be coordinated with those routine activities that require continual Laboratory use of TA-2 and TA-41.

2.8 Technical Objectives

The following subsections address the general technical objectives, the baseline characterization, individual PRS characterization, and field investigation methods.

2.8.1 General Technical Objectives

The technical objectives of this RFI are summarized below:

- Determine whether contaminants are present above screening action levels at each PRS,
- Identify those contaminants that are present above screening action levels,
- Determine the vertical and lateral extent of contamination,
- Identify contaminant migration pathways OU-wide and for each PRS,

- Acquire information to facilitate an initial analysis of quantitative migration pathways and assessment of baseline risk,
- Provide data for preliminary assessment of potential remedial alternatives, and
- Provide the basis for detailed planning of the CMS.

The approaches used to attain these objectives for this OU are outlined in the next several sections. In addition to these technical objectives, management objectives require that the RFI be conducted in an efficient, cost-effective manner and that it be coordinated properly with institutional constraints of the Laboratory.

2.8.2 Baseline Characterization

Characterization of site-specific hydrogeologic and geochemical properties is a specific requirement of Section P of the HSWA Module (EPA 1990, 0306). Baseline characterization will provide information necessary for distinguishing PRS-related contaminants from OU-wide contamination and natural variations in background levels. Characterization during this RFI will help to define the variability of environmental factors relevant to the evaluation of the potential for contaminant migration from individual PRSs.

Because such data are relevant Laboratory-wide, planning for this portion of the RFI has been deferred (to the extent practical) to framework studies investigations, but the baseline characterization essential to this OU is outlined in this OU work plan.

2.8.3 Individual PRS Characterization

A combination of discrete surface sampling and surface radiological surveys for uranium, tritium, plutonium, fission products, and other constituents at TA-2 and TA-41 will be used to define the presence, spatial extent, and distribution of surface and subsurface contamination. Studies of additional characterization boreholes and data derived from the existing and proposed network of characterization borehole wells will be used to assess subsurface units. Details of the characterization plan for each PRS are presented in Chapter 7.

2.8.4 Field Investigation Methods

Common methodologies applicable to the conduct of these RFI activities are summarized in Appendix C of this work plan and are referenced in the individual PRS sampling plans. ER Program standard operating procedures for field survey, field screening, field laboratory, and off-site analytical laboratory measurements will be used for individual PRSs as appropriate.

2.9 Integration with CERCLA, NEPA, and DOE Orders

Section 1.6 of Annex I (Program Management Plan) of the IWP (LANL 1992, 0768) discusses the integration of the RCRA-based ER Program with applicable requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Environmental Policy Act (NEPA). Additionally, the ER Program will comply with all other applicable federal acts, state statutes, and Department of Energy (DOE) orders and policy statements. Appendix I of this OU work plan presents regulatory information and biological information relevant to this work plan.

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

2.10 Natural Resource Damage Assessment

The environmental restoration work at Los Alamos National Laboratory is performed in compliance with the Laboratory's RCRA Part B operating permit. However, this work is also performed in accordance with applicable sections of CERCLA, as required by DOE Order 5400.4 (DOE 1989, 0078). The CERCLA Section 120 extends natural resource damage liability to federal facilities, which includes the Laboratory. The first part of the natural resource damage assessment is a preassessment screen governed by regulations in 43 CFR 11; the preassessment screen will be used to determine whether a full natural resource damage assessment is appropriate. The preassessment screen will be integrated with the CERCLA ecological assessment process for this OU. A general description of the preassessment screen and the ecological assessment is included in Section 5.4 and Appendix I of this work plan. RCRA Subpart S also requires that releases from SWMUs do not pose a threat to the environment; specific methods to evaluate environmental damage are not available, however. Information gathered during any ecological risk assessment activities will also be used in the natural resources damage assessment. Any modifications of the general procedure that might be necessary for this OU will be described in future reports of progress pertaining to this RFI. This procedure is consistent with the *Guidance for Natural Resource Trusteeship and Ecological Evaluation for Environmental Restoration at DOE Facilities, 1991.*

2.11 Voluntary Corrective Actions

Voluntary corrective actions (VCAs) will be taken in situations encountered during the RFI where it is obvious that simple removal of highly localized source terms can be accomplished conveniently and with less expense than that required for extensive characterization. The extent to which VCAs can be taken at Laboratory PRSs which contain mixed waste is limited until the Laboratory's mixed waste storage and treatment/disposal facility is in operation (1997 at the earliest). However, one situation is anticipated during this RFI for which limited VCAs may be appropriate. This situation arises when soil hot spots contaminated well above levels of concern are identified during field activities. If the contamination can readily be shown to be highly localized (as expected in most cases at TA-2 and TA-41), it may be desirable to simply remove the isolated contamination and to confirm its removal by sampling.

This RFI work plan also considers the potential removal of small amounts of contaminated piping and related near-surface debris that may interfere with the field characterization and that represent troublesome future source terms of contamination.

2.12 Modeling

In Chapter 5, site-wide and PRS-specific conceptual models for this OU are presented. These models are based on available information and are used in the development of the field characterization activities described in Chapter 7. As appropriate, the conceptual models will be revised as additional information is acquired during the RFI.

Computational models will be used to evaluate environmental (human-health ecological risk) (following the RFI) and occupational risk (during RFI field work phase). Modeling of geochemical processes and contaminant transport, particularly over long time frames, will be performed as part of the environmental risk assessment. The input required for conceptual and computational modeling will be an important consideration during establishment of the DQOs for the RFI. Therefore, input for the models in part drives the development of the field characterization plans.

Representative examples and sources of the types of computational modeling codes that could be used in the DQO process, both during and after the RFI, include those listed below.

- Dose assessment: RESRAD (DOE)
  CAP88 (EPA)
  GEOEAS (EPA)
  MILDOS (DOE)
- Geochemical/equilibrium: PHREEQE (United States Geological Survey)
  WATEQFC (USGS, University of Colorado)
  MINTEQ (EPA)
- Hydrologic transport: TRACER3D (DOE)
  SESIL (EPA)
  FEHMN

- Surface/air transport: CREAMS (USDA)
  GLEAMS (USDA)
  AIRDOS (USDA)
- Geostatistics/data analysis: GEOPAC (EPA)
  GEOEAS (EPA)

2.13 Framework Studies

Laboratory-wide framework studies will be conducted as part of the Laboratory ER Program's programmatic activities. The framework studies group currently is conducting a pilot study on soils and the Bandelier Tuff to determine the background concentration ranges across the Laboratory for a target list of metals and radionuclides. The investigation will collect data on some physical and chemical parameters that control constituent mobility. Initial results of the study will be presented in the 1993 revision of the IWP and will be available for use in data analysis.

2.14 Conditional Remedies

The concept of conditional remedies is addressed in Section 3.5.2.5 of the IWP (LANL 1992, 0768). The conditional remedy of soil excavation accompanied by long-term monitoring is likely to be appropriate for portions of TA-2 and TA-41, because all contamination may not be removeable as for the past incomplete removal at SWMU no. 2-009 (contaminated soil associated with water boiler reactor) (see Section 6.3 of this OU work plan). Therefore, the field investigation within OU 1098 focuses on our obtaining information adequate to perform soil excavation at portions of TA-2 and TA-41.

As Section 3.5.2.5 of the IWP points out, in cases where the RFI concludes that a conditional remedy is the most appropriate remedial action, a formal CMS may not be required, and the proposed remedy may be presented to the EPA as part of an RFI report. The conditional remedy may be declared the final remedy at that time or the EPA may require further corrective action to supplement or replace the conditional remedy.

2.15 NFA Units

In this OU work plan, several units are identified for which NFA is proposed. Chapter 8 presents the justification and documentation for the NFA recommendations. After EPA approval of this OU work plan, the ER Program Office will file a petition for NFA at these units. This petition will be included in the annual update to the IWP, wherein it will request formal EPA approval of all proposed NFA units across the Laboratory's ER Program through a permit modification.

CHAPTER 2 REFERENCES

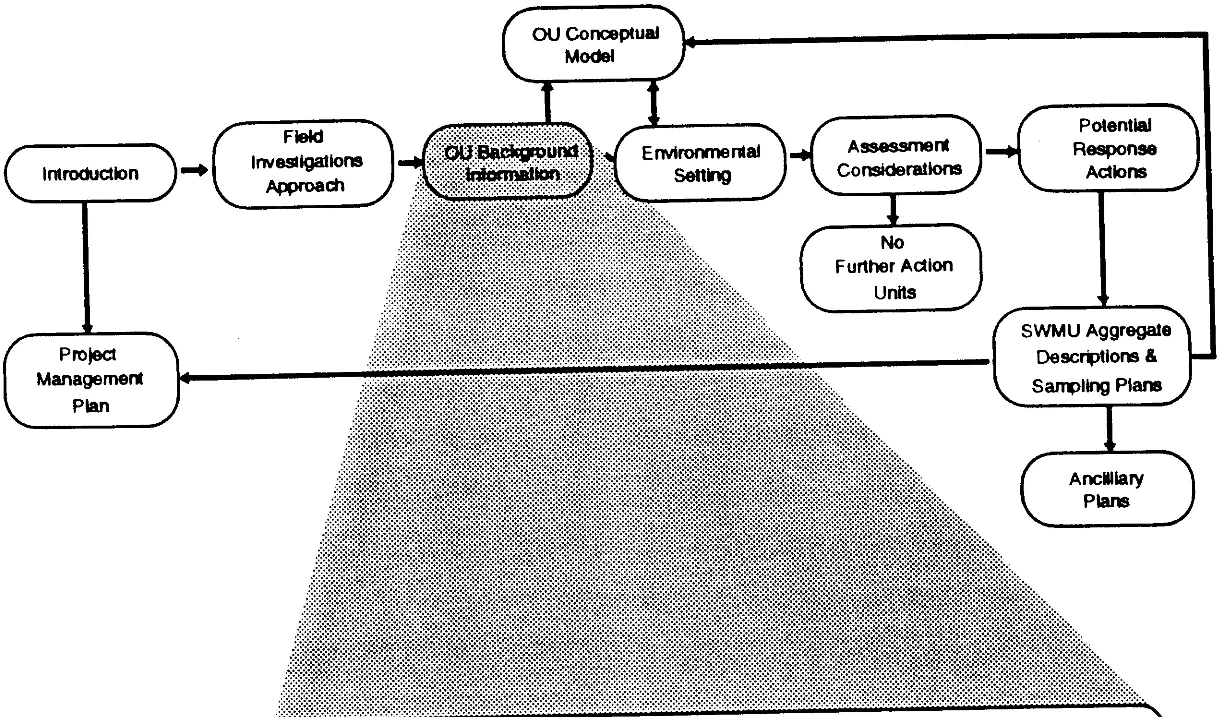
DOE (US Department of Energy), October 6, 1989. "Comprehensive Environmental Response, Compensation, and Liability Act Requirements," DOE Order 5400.4, Washington, DC. (DOE 1989, 0078)

EPA (US Environmental Protection Agency), March 1987. "Data Quality Objectives for Remedial Response Activities, Development Process," EPA 540/G-87/003, OSWER Directive No. 9355.0-7B, prepared by CDM Federal Programs Corporation, Washington, DC. (EPA 1987, 0086)

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

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

Chapter 3



Background Information for the TA-2 and TA-41 Operable Unit

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

CHAPTER 3.0 BACKGROUND INFORMATION FOR OPERABLE UNIT 1098

This chapter presents a brief overview of current and past uses of Technical Area (TA)-2 and TA-41. Greater detail is contained in Chapter 7 where individual PRS field investigations are described. Figures EXEC-2, EXEC-3, and EXEC-4 show the locations of TA-2 and TA-41 within the Laboratory as well as individual structures and PRSs.

3.1 Location

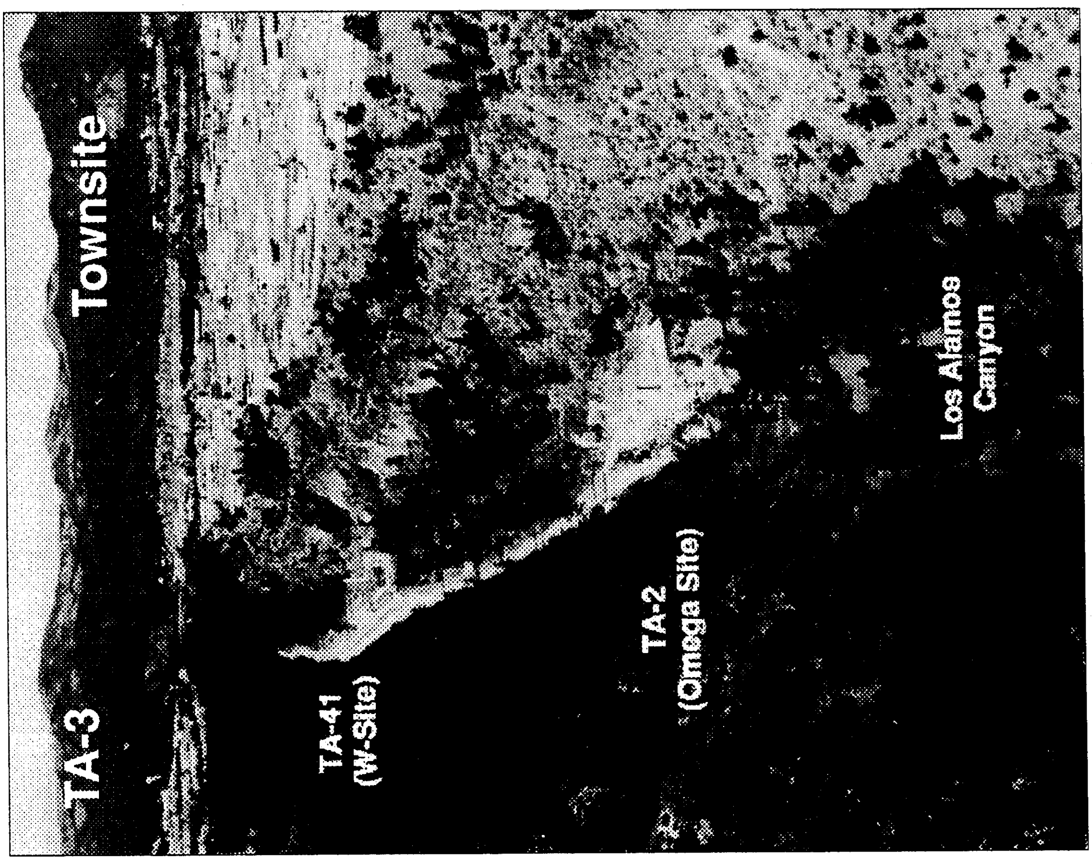
Technical Area-2 and TA-41 [which together comprise Operable Unit (OU) 1098] are part of the Los Alamos National Laboratory, which is located in Los Alamos County in northern New Mexico, approximately 24 miles northwest of Santa Fe. Developments within Los Alamos County include the Los Alamos and White Rock residential areas and the Laboratory's technical areas. Los Alamos County is situated on the Pajarito Plateau, a region 5 to 6 miles wide and 6500 to 7600 feet above sea level, between the 10,500-ft-high Jemez Mountains to the west and the 5500-ft-high Rio Grande Valley to the east. The plateau is cut by many deep finger canyons that run generally west-northwest to east-southeast from the mountains to the Rio Grande.

The Los Alamos town site and most technical areas of the Laboratory generally occupy relatively flat mesa tops situated between the canyons. In contrast, both TA-2 and TA-41 are located at the bottom of Los Alamos Canyon between two of these mesas. In the vicinity of TA-2 and TA-41, Los Alamos Canyon is approximately 1350 feet wide at the top, and varies in depth (350 ft to 360 ft). Phase I and II investigations conducted as part of OU 1098 will include the canyon bottom to the canyon walls within Los Alamos Canyon. The sides of the canyon are exceedingly rough and rocky and are partially covered by trees, particularly on the south side. The bottom of the canyon is wooded and relatively flat for a width of about 600 ft. A small stream passes along the bottom of the canyon. This stream is ephemeral in the vicinity of TA-2 and TA-41, although the flow is extremely variable. The Los Alamos Canyon Reservoir, located off of Laboratory property upstream from TA-2 and TA-41, provides a constant source of surface water to the stream. Farther downstream (east) of TA-2, the stream is intermittent. A paved road provides access to TA-2 and TA-41 and is accessible from the Laboratory and the town of Los Alamos.

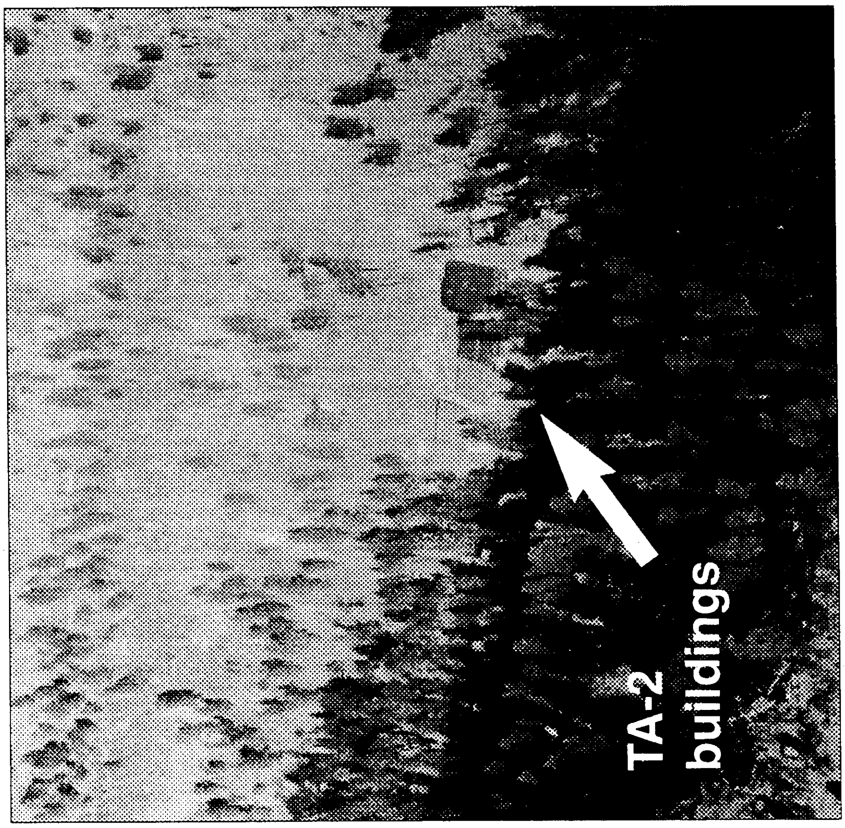
Detailed engineering drawings, site maps, survey coordinates for buildings, and other information relevant to the TA-2 and TA-41 (RFI) are contained in Appendix B (see Figures EXEC-3 and EXEC-4 for locations of potential release sites at OU 1098). Figures 3.1-1(a)-(e) present aerial photographs of TA-2 taken at various times since 1946. Photographs of TA-41 are shown in Figure 3.1-2 (a) and (b).

3.2 History

This section describes the prehistoric and early uses of the area and discusses environmental monitoring at TA-2 and TA-41.

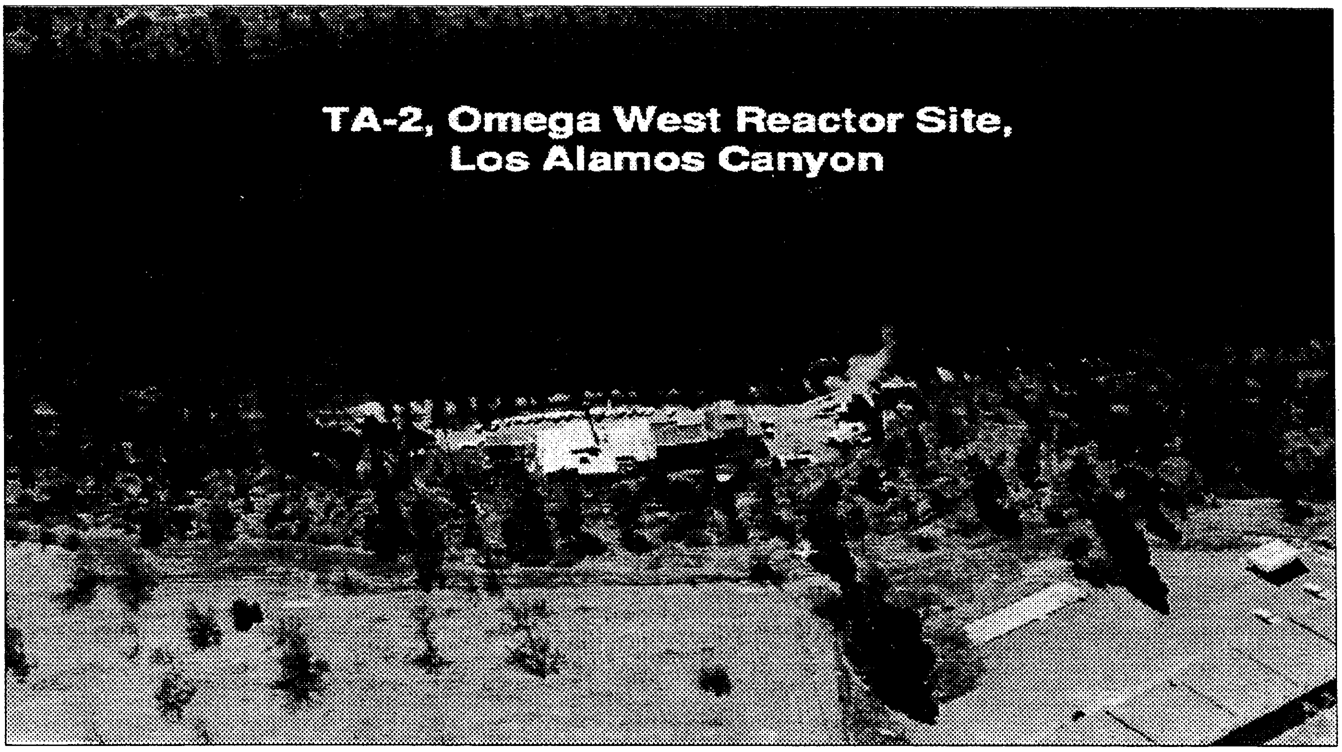


(a) Photograph viewing west, showing OU 1098 including TA-2.



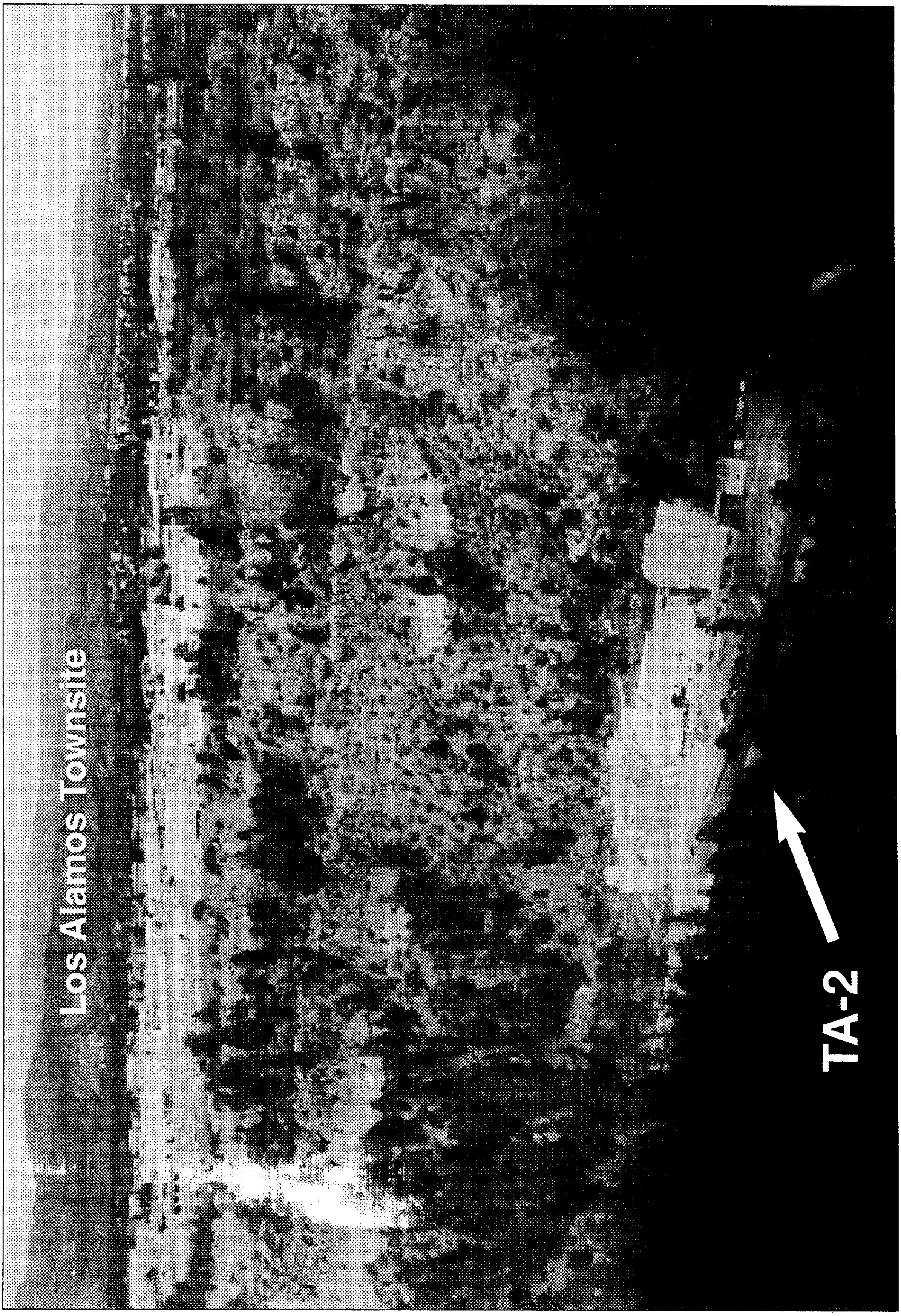
(b) December 1946 photograph viewing north, including TA-2.

Figure 3.1-1 Aerial photography of TA-2 from 1946 to the present.

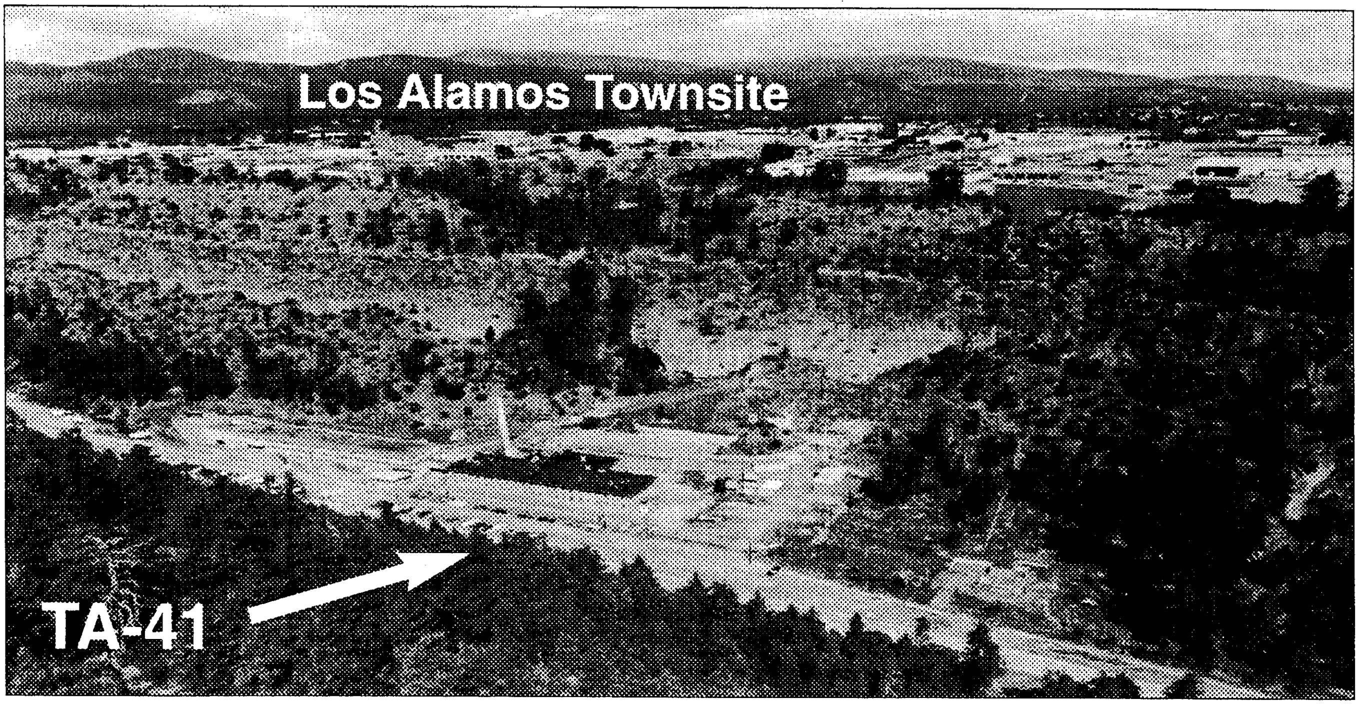


(c) 1979 photograph viewing South, including TA-2.

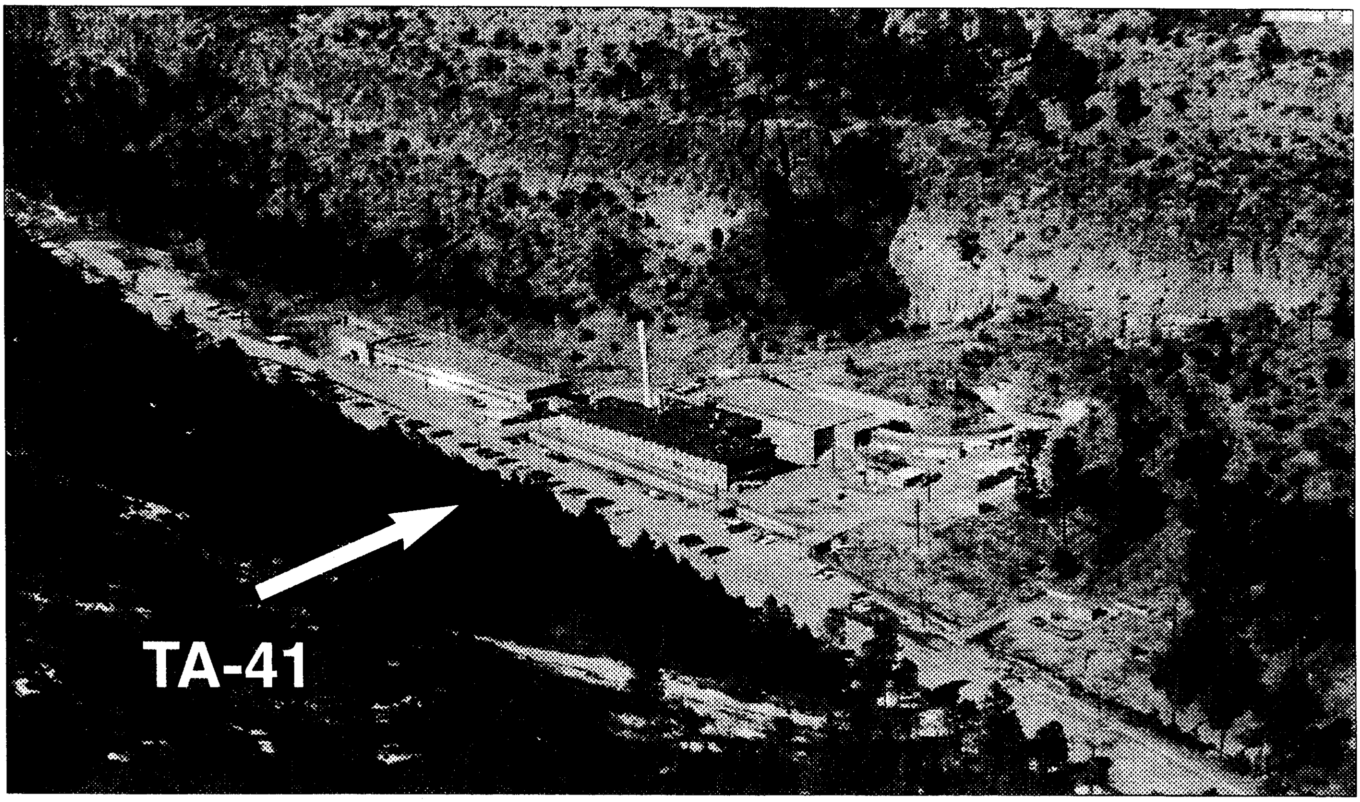
(d) 1989 photograph viewing North, including TA-2.



(e) 1991photograph viewing North, including TA-2 and Los Alamos Townsite



(a) 1989 photograph viewing North-West, including TA-41 and Los Alamos Townsite



(b) 1991 photograph viewing North-West, including TA-41.

Figure 3.1-2 Aerial photographs of TA-41 from 1989 to 1991.

3.2.1 Prehistoric Uses

DP Mesa and Mesita de Los Alamos, located to the north and south of Los Alamos Canyon, respectively, have experienced some prehistoric use (Steen 1977, 0660; Steen 1982, 0659). A cultural survey of OU 1098 was carried out to be used in conjunction with this RCRA Facility Investigation (RFI) in furtherance of National Environmental Policy Act (NEPA) requirements . The survey documents this use and assesses the potential impact of the RFI on cultural resources. Results of this survey will be reported in a later document. It is expected that a categorical exclusion for NEPA assessments on RFI activities will be issued by the DOE, as was done for adjacent TA-21.

3.2.2 Early Historic Uses

Much of the Pajarito Plateau, including present-day TA-2 and TA-41, was part of the Ramon Vigil land grant. In the late 1800s and early 1900s, the Pajarito Plateau, including portions of Los Alamos and DP Mesas were used for ranching, farming, and timber production. Aerial photographs of TA-2 and TA-41, however, suggest that such uses in the areas of present-day TA-2 and TA-41 within Los Alamos Canyon probably did not extensively take place.

DP Mesa and Mesita de Los Alamos were added to the Santa Fe Forest Reserve along with the rest of the Jemez Section in 1915. Based on extensive archival search, examination of aerial photographs, and interviews with many former Laboratory employees, it has been established that the Laboratory has used the land within Los Alamos Canyon at TA-2 and TA-41 continually since the 1940s. General public activities in the Canyon occur at Los Alamos Canyon Reservoir and at the Los Alamos ice skating rink to the west of the TA-2 and TA-41 sites.

3.2.3 Environmental Monitoring at TA-2 and TA-41

As described in greater detail in Chapter 4, site monitoring has been carried out by the Environmental Surveillance Group (ESG) at TA-2 and TA-41 on a continual basis since 1966. These results have been reported in the Laboratory's annual environmental surveillance reports and other special reports, which extend back to 1966 (ESG 1990, 0497; Elder and Knoell 1986, 14-0014; Montoya 1991). Annual monitoring of six shallow monitor wells located in Los Alamos Canyon has suggested contamination in the alluvial aquifer groundwater (ESG 1990, 0497). These wells are described in detail in Section 4.4.3 and locations are shown on Figure 4.4.2. As described in Chapters 4 and 5, tritium, cesium-137, and strontium-90 are the major constituents, as indicated by groundwater quality data collected by ESG (ESG 1990, 0497). Measurable surface sediment contamination attributable to TA-2 and TA-41, within the creek channel, has been found beyond the OU 1098 boundary within TA-21 to the east within Los Alamos Canyon.

Radionuclide contamination above background and generally below possible ranges of screening actions levels, which are under development as discussed in Chapter 6, has been observed in groundwater and surface-sediment samples from areas east of TA-2 and TA-41. A few samples from locations east of TA-2, where low-level, near-surface radionuclide releases are known to have occurred within TA-2, have yielded individual soil samples with fission product (cesium-137) concentrations which may exceed the screening action levels for radionuclides which are being developed by the Laboratory as discussed in Chapter 6. Past sampling indicates that this contamination is mobile and highly variable, depending on location and time of sampling. Further details on the nature of this surface contamination are given in Chapters 4, 5, and 7.

3.3 Past Operational Practices at TA-2 and TA-41

Technical Area-2 and TA-41 have been continuously used from the early 1940s to the present. Technical Area-41 is used for weapons development and long-term studies on weapon subsystems. Technical Area-2 has been used continuously since 1943 to house a series of research reactors (Bunker 1983, 14-0012). Early reactors were fueled by aqueous uranyl solutions, whereas other reactors, including present-day Omega West Reactor (OWR), were fueled by solid fuel elements. The earliest of these reactors consisted of three successive homogeneous liquid-fueled reactors, including the first ever of that type (water boiler) which was assembled in late 1943. These reactors were fueled by aqueous solutions of a uranium salt, enriched in uranium-235; the last modification was deactivated in 1974. The first of the solid-fuel reactors involved a now-decommissioned plutonium-fueled, mercury-cooled reactor. The reactor system was self-contained and operated from 1946 to 1953. Since 1956, TA-2 has been the operating site of OWR, an 8-MW, water-cooled research nuclear reactor fueled by highly enriched uranium contained as solid fuel.

3.3.1 Sources of Residual Radioactivity at TA-2 from Previous Operations

This section provides an overview of residual radioactivity at TA-2 from previous operations that contribute contaminant source terms at the different PRSs. This information is presented because it describes residual radioactive source terms that are important to the RFI investigations.

Radiolytic and fission product gases (argon, xenon, krypton) were released directly at TA-2 on a small scale through a gaseous effluent line and stack from the time of the earliest of the water boiler reactors. The primary source of residual radioactivity was derived from the gaseous effluent line (SWMU no. 2-009). The decommissioning of the gaseous effluent line primarily involved removal of small external structures, underground pipes, and contaminated soil. Survey methods and soil cleanup guidelines for this project primarily dealt with residual radioactivity in soil and sediments (Elder and Knoell 1986, 14-0014).

In the early operation of the succession of water boiler reactors, hydrogen and oxygen that arose from the radiolytic dissociation of water associated with reactor operation were not combined (Elder and Knoell 1986, 14-0014). In 1951, a gas recombination system was installed that reduced the explosion hazard as well as the quantity of radioactively contaminated gas requiring discharge to the atmosphere via the gaseous effluent system. This gaseous effluent system made up most of the piping and structures that needed to be removed in Phase I of decommissioning. During the 25-KW operation, approximately 220 cm^3/min of gas (excess air and some fission products) flowed into the gaseous effluent line. The radioactive gaseous isotopes of oxygen, nitrogen, argon, xenon, and krypton were discharged through this line and routinely monitored. This line ran underground and eventually terminated at the top of an adjacent mesa (Mesita de Los Alamos) in a 150-ft stack south of TA-2 (SWMU no. 2-006a). A centrifugal blower at the stack base provided adequate draft for gas flow in the long pipe.

From 1986 to 1987, removal of external structures and underground piping associated with the gaseous effluent (stack) line from the water boiler reactor was performed as Phase I of that reactor's decommissioning (Elder and Knoell 1986, 14-0014). Six concrete structures were dismantled and 435 ft of contaminated underground piping were removed and disposed of at TA-54. Soil contamination by cesium-137 was encountered around structure TA-2-48 (See Subsection 7.10 for details), which contained a condensate trap/line [SWMU 2-003(b)], and also in a former leach field near the stream (SWMU 2-007). Efforts to remove all contaminated soil were hampered by infiltrating groundwater and heavy rainfalls. Guidelines for concentrations of residual radioactivity in soil after the lines and structures had been removed were based on the general principle of as low as reasonably achievable (ALARA). Under this principle, the primary consideration was to keep any future exposure of employees or the general public to the remaining radioactivity to as low a level as technically and economically reasonable. To expedite decision making, *de minimus* levels of soil concentration and upper limit concentrations guides were used (Elder and Knoell 1986, 14-0014). These *de minimus* levels, which are described in Table 3.3-1, were used for remedial decision making in 1986-87, but are not screening action levels for radionuclides (see Chapter 6).

TABLE 3.3-1

SOIL CONCENTRATION GUIDELINES (ABOVE BACKGROUND) CONFORMING TO DE MINIMUS LEVELS AT TA-2

	SURFACE SOIL[a]	SUBSURFACE SOIL[b]
Gross alpha	Nondetectable[c]	75 pCi/g
Gross beta	25 pCi/g	75 pCi/g
External gamma[d]	5 µR/h	20 µR/h

[a] Surface soil: located within 5 ft (1.5 m) from the surface.

[b] Subsurface soil: located at any depth greater than 5 ft (1.5 m).

[c] Detector background plus 3 sigma counting error.

[d] If Cs-137 is present.

Residual soil and sediment contamination, consisting of 1000 pCi/g of cesium-137, however, occurs at depths greater than 5 ft. Complete remediation efforts were not possible, because of the high water table that impeded cleanup operations (Elder and Knoell 1986, 14-0014). A stabilized, clean fill with depths ranging from 5 to 7 ft was placed over this area. Approximately 970 m^3 of low-level radioactive waste resulted from the cleanup operations. Waste generated by the Water Boiler Reactor Decommissioning Project (WBRDP) was either buried in pits or placed in shafts at TA-54, Area G (Montoya 1991, 14-0015).

3.3.1.1 Previous Subsurface Soil Guidelines at TA-2

Elder et al. (1986, 0456) investigated a variety of pathways at TA-2 by which buried radioactive material could reach the biosphere and result in a dose to humans. Pathways that were evaluated include:

1. Erosion of the material and its covering soil, and subsequent flow into surface-water systems used for drinking water and irrigation,
2. Leaching into groundwater,
3. Resuspension of material exposed by erosion, and
4. Human habitation and agriculture on exposed material.

The results of this investigation demonstrated the most critical pathway for long-lived radionuclides to be human habitation and agriculture on contaminated soil where soil cover had been eroded away. The three most restrictive scenarios are summarized in Table 3.3-2 (Elder et al., 1986, 0456).

TABLE 3.3-2

SUMMARY OF SCENARIO CALCULATIONS FOR THE SUBSURFACE SOIL GUIDELINES (pCi/g)[a]

Radionuclides	Erosion Scenario	Locating a Home on Excavated Soil	Excavation of Contaminated Soil
americium-241	600	675	724
plutonium-239, 240	2400	2700	1942
plutonium-238	4200	4726	3185
uranium-238	960	1080	5550
uranium-235	960	1080	5550
uranium-234	960	1080	5550
cesium-137	960	1080	3360
strontium-90	1200	1350	2.8×10^6
hydrogen-3[b]	-	120 000	4.0×10^6

[a] Soil activity concentration above natural background which could result in a dose to any organ of 500 mrem/yr.

[b] pCi/ml of soil moisture.

- Not calculated.

3.3.1.2 Sources of Radioactivity from OWR Operations

The OWR operates at a power of 8 MW; safe dissipation of this heat requires cooling water flow of approximately 3500 gal./min over the fuel cladding surfaces (Penneman 1992, 03-0012; Safety Analysis Report for Omega West Reactor 1992). The high neutron flux activates trace impurities in the cooling water, as well as the gases oxygen, nitrogen, and argon that are present from dissolved air. Fission products are contained within the solid fuel. The radioactive oxygen, nitrogen, argon, xenon, and krypton gases, together with argon-41 plus hydrogen and oxygen from water decomposition, are vented to the atmosphere at low levels, which are monitored by INC-15 and EM-8. The principal radionuclides normally present in the reactor cooling water are tritium, nitrogen-16, sodium-24, aluminum-28, magnesium-27, chromium-51, zirconium-65, antimony-124, iron-49, molybdenum-99, silver-110, cobalt-60, and either or both zirconium-95 and niobium-95. The noble-gas fission products xenon-133, xenon-135, and krypton-85 are present together with argon-41, formed from activation of the 1% argon present in ordinary laboratory air.

The greatest contributors to the gross water activity from all of the above listed isotopes are the 7-second half-life nitrogen-16 and 15-hr half-life sodium-24 isotopes. These isotopes rapidly decay and therefore do not pose a long-term risk. A silt-like coating, which adheres to the walls of the cooling water piping system, retains some of the metallic radionuclides mentioned above. The presence of this radioactivity is considered during piping changes/repairs.

Releases of tritium resulted from a leak in the primary cooling water system at OWR. The leak occurred from a break in a weld seam in a section of the delay line running from building TA-2-1 to the surge tank. This release was discovered in January 1993 and was within the Guaje Mountain fault zone. Tritium was leaking from the delay line at a rate of up to 70 gallons per day until March 1993 when the cooling water was drained from this line. Typical concentrations of tritium in the cooling water ranged from 15.7 x 10^6 to 20.2 x 10^6 pCi/L

3.3.2 Past Operational Practices at TA-41

Technical Area-41 has been used for nearly five decades. It continues to be utilized for testing, monitoring, and assembling of nuclear weapon components,for development of weapon subsystems and boosting systems, and for appropriate long-term studies on critical systems.

Technical Area-41 contains the Ice House (IH) and Main Storage Vault (MSV) (see Figure EXEC-4), which provide the DOE with facilities for testing, monitoring, assembling, and storing nuclear weapon components (Penneman 1992, 14-003). The MSV was designed by Black and Veatch Consulting Engineers of Kansas City, Missouri, in 1948 and was constructed by Brown & Root, Inc., of Houston, Texas, in 1949. The IH and MSV together with other facilities at TA-41 are managed and operated by the Laboratory. There are also offices and shop facilities at TA-41. Facility maintenance is handled by Johnson Controls World Services.

Components that contain such radioactive materials as uranium (enriched in uranium-235), plutonium, and tritium are often present. Nonradioactive but hazardous or potentially hazardous materials also on site, include arsine, lithium, mercury, beryllium, lead, cadmium, nickel-cadmium-mercury batteries, explosives, and thermite-type heat generators. A photographic laboratory is also on site. Organic chemicals have also been used on site on a laboratory scale or small quantities. A list of chemicals previously used at TA-41 is presented in Table 3.3-3.

TABLE 3.3-3
CHEMICALS CURRENTLY IN USE AT TA-41
(October 1992)

acetone	kerosene
acetylene	krypton
ammonia (gas)	lead
argon	lithium deuteride
arsine	lithium hydride
beryllium	mercury
cadmium	methane
carbon dioxide	methyl alcohol
deuterium	neon
ethyl alcohol	nitric oxide
ethylene glycol	nitrogen
helium	oxygen
hydrogen	plutonium
hydrogen deuteride	silver
hydrogen iodide	tritium
isopropyl alcohol	uranium

Little liquid radioactive waste has been generated in the work done at TA-41. Plutonium alloys are protectively clad with a skin of an inert metal to prevent alpha contamination. Dispersion of uranium alpha contamination occurs when workers swipe laboratory surfaces with swabs (Kimwipes) moistened with solvent. The swabs are placed in special containers for radioactivity that are then collected and removed from the site. This general procedure of segregating and collecting waste is followed with all waste, and none of it is disposed of on site. The three types of waste handled in this manner are nonradioactive waste, radioactive waste, and mixed waste.

Tritium gas is kept in special containers, often double or triple contained. Special efforts are expended for the recovery and conservation of tritium. However, essentially every surface contacting tritium, such as high-pressure pipe interiors, becomes contaminated to some extent. There have also been some releases of tritium gas into hoods and subsequently into the ventilation effluent stack, which are monitored by EM-8. All such releases are kept to a minimum and are monitored and recorded.

3.3.2.1 Mass Spectrometry of Plutonium at TA-41

Most of the past work with plutonium at TA-41 involved metal alloys that were clad with an inert metal such that no alpha activity could escape. From 1954 to 1973, isotopic analyses of Nevada Test Site (NTS) samples containing plutonium and uranium were performed at TA-41. The work was performed with mass spectrometers, which were located on the bottom floor at the west and east ends of building TA-41-004. The instruments occupied rooms on both sides of the hallway and the rooms had doors leading directly to the outside.

Small volumes of solution samples were prepared at TA-48 before they were delivered to TA-41, being brought directly to the outside door and into the N mass spectrometer room. These samples normally contained several µg of plutonium or several mg of uranium. Preshot samples were contained in 1-dram vials with plastic caps, and the postshot samples were contained in coned-bottom vials, with a volume of about 3 ml, and fitted with ground glass stoppers. The vials were stored in plastic trays, which were drilled out to hold just the vials. These trays were stored either in rectangular steel cans or in locking file safe drawers located in the S Laboratory. Aliquots in 2 Normal nitric acid containing 300 to 500 ng of plutonium or 100 to 500 mg of uranium were deposited on rhenium filaments and evaporated to dryness in hoods in the N Laboratory. Residual samples were kept for 1 or 2 yr and then disposed as hot waste, which was then taken to TA-54.

In addition to these radioactive samples, isotopic analyses were also performed on the much more alpha-active plutonium-238, resulting in several instances of contamination, primarily in the hood area. One of the original mass spectrometers which became alpha-contaminated was removed and buried.

3.4 Current Waste Management Practices at TA-2 and TA-41

Four major categories of solid waste are generated at TA-2 and TA-41. Each of the categories is handled in accordance with approved procedures. The four general categories are:

1. Nonradioactive and nonhazardous,
2. Hazardous and nonradioactive,
3. Radioactive and mixed waste (nonfuel), and
4. Spent fuel elements.

Waste classified as "nonradioactive and nonhazardous" is handled as sanitary landfill waste. This material is disposed of at the Los Alamos sanitary landfill. The Laboratory's maintenance contractor is responsible for the transport and disposal of this category of solid waste.

Waste classified as "hazardous and nonradioactive" is transported to TA-54 for treatment and disposal or recycling at a commercial facility. The Laboratory organization responsible for this category is the Waste Management Group (EM-7).

Nonfuel waste classified as "radioactive and mixed waste" is handled in one of two ways. If the waste is classified as low-level waste (LLW), it is transported by truck in Department of Transportation (DOT)-approved containers for disposal at the Laboratory's land burial facility within TA-54. Waste other than LLW is packaged and stored for disposal at other Department of Energy (DOE) facilities. EM-7 is responsible for the disposal.

Spent-fuel elements generated at OWR are categorized as "high-level radioactive waste." The elements are transported in Laboratory-approved containers, four at a time, from TA-2 to a hot cell at TA-3. At TA-3, they are transferred to a DOT-certified shipping cask. The shipping cask is then transported to a processing plant at the Idaho National Engineering Laboratory. Such shipments occur about every 2 years.

Technical Area-2 has three 1000-gal. and one 170-gal. underground storage tanks for radioactive effluents. Radioactive liquids are piped to these tanks. The major source of radioactive effluent results from the periodic regeneration of the deionizers. No chemical treatment is performed at TA-2. Radioactive effluents are periodically pumped via pipeline or tank truck to the Laboratory Waste Management group (TA-50) for treatment and disposal.

3.5 Site Access and Control

Access to buildings at TA-2 and TA-41 is controlled by guard gates present at the sites. Technical Area-2 and TA-41 are protected by 8- to 10-ft security fences. The gates across the main access road to TA-2 are kept locked when the sites are not under the direct surveillance of authorized employees. These gates are kept open when there are authorized employees at the sites to permit access to the parking areas. The parking areas and entrance road are separated from the rest of TA-2 by fences that extend either to buildings or to locked gates. During working hours, all doors and gates that open onto the parking areas are kept locked, with the exception of the door to the main offices, which are occupied. Other doors may be left unlocked while they are under employee surveillance.

3.6 Migration Pathways

Pathways or receptors have both short-100 yr and long-term (greater than 100 yr) significance at TA-2 and TA-41, because TA-2 and TA-41 are located in Los Alamos Canyon. Operable Unit 1098 is located near the town site, and contaminant-transport pathways, via atmospheric dispersion, are possible under past and current site conditions. Groundwater pathways are also possible, due to the shallow depth to alluvial groundwater and the presence of transport mechanisms. Surface waters are of significance because some of existing TA-2 and TA-41 contaminants were discharged to the creek banks or surface water. Groundwater pathways are of concern because of the tritium leak discovered in the primary cooling system of the OWR in January 1993. High activities of tritium, typically ranging between 20,000 and 59,000 pCi/L, were found in surface water and groundwater samples collected at TA-2.

In the context of this work plan, "short-term" will imply the 100-yr time frame assumed for institutional control. "Long-term" relates to land use changes beyond this time frame (e.g., after loss of institutional control), and includes climatic changes that may occur, which could alter exposure pathways such as:

- Exposure of buried contaminants through erosion, followed by surface run-off and sediment transport or aerial resuspension,
- Artificial site disturbance,
- Surface-water transport,

- Infiltration through the vadose zone, and
- Chemical, physical, and biological transport.

It is quite possible that the above pathways could also change within the short term, depending mainly on weather conditions and related factors such as flooding. Some of the wastes at TA-2 and TA-41 will remain hazardous much longer than the 100 yr assumed for institutional control. For these reasons, soil and groundwater remediation, accompanied by monitoring and stabilization, have been identified as the likely remedial actions to be taken at TA-2 and TA-41. This approach is consistent with the conditional remedy concepts described in Chapters 4 and 5 of this OU work plan and in Section 3.5.2.5 of the Installation Work Plan (IWP) (LANL 1992, 0768).

3.7 Overview of PRSs at OU 1098 (TA-2 and TA-41)

This section provides a brief overview of the 17 SWMUs and five AOCs addressed in this OU work plan. The locations of these PRSs are indicated on Figures EXEC-3 and EXEC-4.

Table 1.2-1 assigns these PRSs to investigation groups as follows:

- TA-2 SWMUs,
- TA-41 SWMUs, and
- AOCs.

A detailed description of TA-2 and TA-41 PRSs and the corresponding field investigation plan are presented in Chapter 7. No further action units are discussed in Chapter 8.

For the purpose of developing the data quality objectives (DQOs) that underlie the proposed field investigations, we have categorized the TA-2 and TA-41 PRSs as follows (see Char'er 6 of this OU work plan for a discussion of future land use and possible re al alternatives at TA-2 and TA-41):

- ***TA-2.*** Contaminant source terms (uranium, chromium, cesium-137, plutonium, beryllium, and fission products) may exist in the subsurface soils and sediments (DOE 1987, 0264). Localized source terms (soil and debris) above screening action levels may also exist near the surface. Several remedial options are conceivable for the near-surface contamination. Because removal or treatment of the contaminated soil and sediment is likely to be practical, this work plan considers soil excavation and groundwater extraction to be the most likely remedial measure to be selected for most of the PRSs following the RFI/CMS (Corrective Measures Study).

- ***TA-41.*** Technical Area-41 is suspected to contain soil and groundwater contamination, primarily due to the release of tritium and possibly to an alpha-contaminated sewage outfall. A septic system (SWMU no. 41-001) and sewage treatment plant (SWMU no. 41-002) are considered to be the two most important PRSs at TA-41 (DOE 1987, 0264). The building structures are not contaminated with radionuclides, excluding tritium, based on monitoring data collected by WX-5 (Larson 1992, 14-002). Five AOCs exist at TA-41: a sump, a 560-gal. diesel tank, an industrial waste tank (which may never have existed), storm drains, and a fuel tank with unknown origin.
- The RFI is likely to show that most of the areas within TA-2 will be reserved for Restricted Laboratory Use. However, available information suggests that a few of the PRSs within TA-2 and TA-41 are not likely to contain significant source terms and, therefore, the no further action (NFA) alternative is the probable recommendation for some PRSs.

Radiological and chemical constituents, including uranium, plutonium, tritium, fission products, chromium, mercury, acids, and solvents, represent the most significant materials used at TA-41 and TA-2. They are the primary focus of PRS-specific investigations. Other constituents are known or suspected to exist at TA-2 and TA-41 only in limited quantities and generally will be associated with the aforementioned contaminants. These factors have been taken into account in development of the sampling plans contained in Chapter 7.

Analyses of RCRA metals and organic compounds and nonregulated metals and radionuclides, however, will be conducted for a limited number (10-20%) of samples of soils, sediments, surface water, and groundwater obtained in the baseline portion of Phase I sampling.

3.7.1 PRSs at TA-2 and TA-41

Thirteen PRSs have been identified at TA-2 and aggregated as part of OU 1098. TA-2 contains PRSs consisting of an underground diesel fuel tank, decommissioned reactor waste units, storage pits and tanks, cooling tower drift loss, waste lines, drains, decommissioned septic system, outfalls, operational releases, and chemical shack waste units. Primary wastes at TA-2 consist of uranium, chromium and other metals, acids, fission products, possibly some transuranic (TRU) elements, and organic compounds, including PCBs and solvents. Water treatment released significant amounts of potassium dichromate from the cooling tower into the canyon environment. Historical information indicates that up to 5000 pounds of potassium dichromate may have been released to the environment from the TA-2 cooling tower (Penneman 1992, 14-0003).

The SWMUs at TA-41 consist of a septic tank, a sewage treatment plant, a sump, and a container storage area. Operations at TA-41 involve handling and storage of tritium, plutonium, uranium, and beryllium in assemblies, also arsine, hydrogen, deuterium, liquid nitrogen, and squibs that contain explosives residues (see Table 3.3-3 for a list of chemicals used in the past at TA-41).

3.8 Sources of Information

Current standard practices and methods were used to acquire available environmental data for TA-2 and TA-41. These data are used in this document solely to guide RFI characterization and sampling.

Extensive use was made of direct interviews of many key personnel who were involved in past activities at TA-2 and TA-41. Included in this group were radiation/health monitors and long-term staff members of TA-2 and TA-41. Access to these individuals, combined with historical documentation and environmental monitoring conducted since 1966, assisted in the development of the individual site descriptions with a moderate degree of certainty and completeness.

Other information sources have been used:

- The Laboratory's environmental monitoring network, which includes near- and on-site stations as well as perimeter and regional stations that are not influenced by Laboratory operations. These studies are reported in annual reports of the environmental surveillance group,
- Special studies conducted at the Laboratory and in the region, which collected environmental data in areas unaffected by Laboratory operations. These studies are described in periodic Laboratory reports,
- General environmental data addressing the behavior of various compounds, elements, and radionuclides in natural systems. These reports are available in peer-reviewed scientific literature, and
- Unpublished internal Laboratory memoranda, reports, and drawings.

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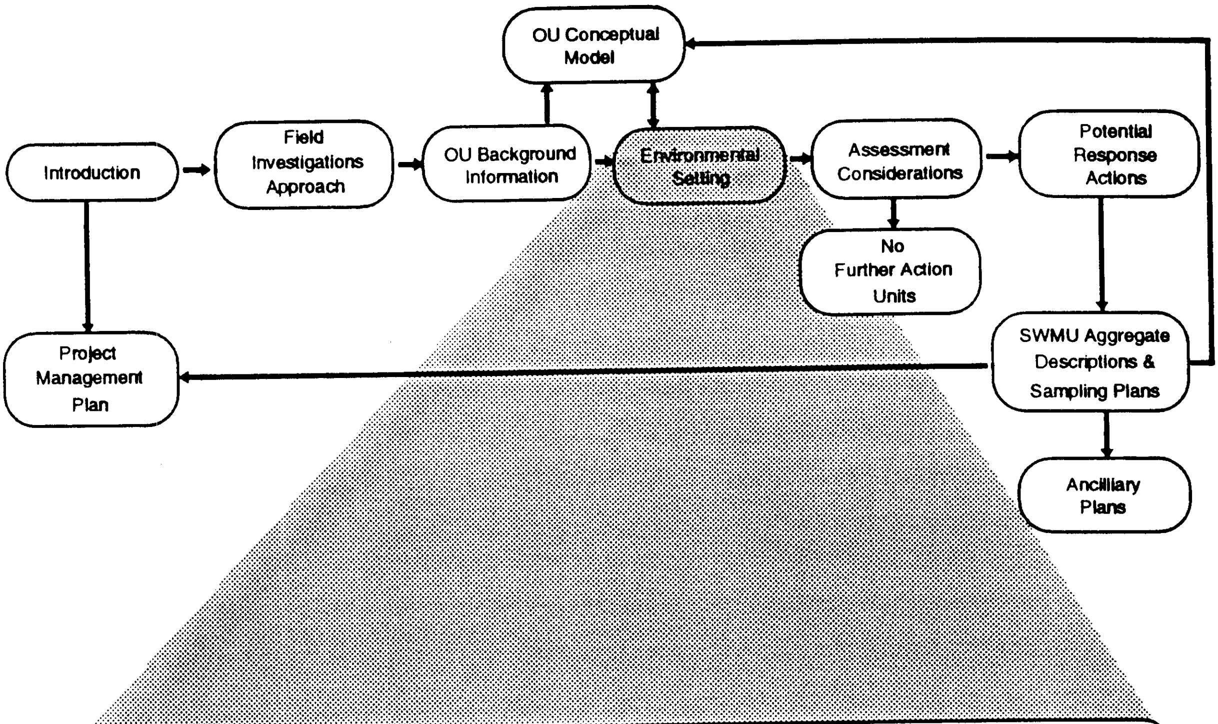
Chapter 4



Environmental Setting

- Location and Topography
- Climate
- Surface Deposits
- Hydrology
- Geology

CHAPTER 4 ENVIRONMENTAL SETTING OF OPERABLE UNIT 1098

Chapter 4 presents a detailed description of the environmental setting at operable unit (OU) 1098 [Technical Area-2 (TA-2) and TA-41] on which the Potential Release Site (PRS)-specific RCRA Facility Investigation (RFI) plans in Chapter 7 and the recommendations for no further action (NFA) (Chapter 8) are based. All PRSs not recommended for NFA located at OU 1098 will be investigated during Phase I or Phase II activities. The regional environmental setting of the Laboratory as a whole is discussed in Chapter 2 of the Installation Work Plan (IWP) (LANL 1992, 0768).

Chapter 4 presents and interprets existing information relevant to TA-2 and TA-41.

- 4.1 Location and Topography
- 4.2 Climate
- 4.3 Surface Deposits
- 4.4 Hydrology
- 4.5 Geology
- 4.6 Biological Setting

Sections 4.1 through 4.6 provide a general foundation culminating in a conceptual model described in Chapter 5. Chapter 4 also identifies additional information needs related to (1) expanding the conceptual understanding of the environmental processes at TA-2 and TA-41 and (2) assessing the magnitude and importance of potential exposure routes within OU 1098.

The general data requirements described in Chapter 4 and conceptual model identified in Chapter 5 are used to develop the PRS-specific field sampling plans presented in Chapter 7. As field results become available, an iterative process will begin in which current knowledge will be updated, the sufficiency of the data for supporting the RFI objectives will be assessed, additional data needs will be identified, and further investigations will be designed to fulfill those needs.

4.1 Location and Topography

Technical Area-2 and TA-41 are located in Los Alamos Canyon on the northern edge of the Laboratory. The northern and southern boundaries of TA-2 and TA-41 are at the near-vertical cliff faces where the Bandelier Tuff is exposed. Los Alamos Canyon at OU 1098 is bounded on the south by Mesita de Los Alamos and on the north by DP Mesa. The canyon bottom where OU 1098 is located varies in width from 400 to 460 ft. Technical Area-41 lies at elevations between 6900 and 7000 ft above sea level (asl), whereas TA-2 lies at elevations between 6800 and 6900 ft asl (see topographic map in Appendix A). Los Alamos Canyon is oriented in a general east-west direction and is centrally located on the Pajarito Plateau. Surface drainage patterns from the mesa top generally are oriented to the east, north, and south and feed into Los Alamos Canyon. The Plateau is located between the Jemez Mountains to the west and the White Rock Canyon of the Rio Grande to the east (Figure 4.1-1).

The Los Alamos Canyon drainage area extends to the drainage divide on the Sierra de los Valles and runs eastward to the Rio Grande near Otowi. During the summer, storm-water run-off occasionally reaches the Rio Grande. Los Alamos Canyon has cut into the Tshirege Member and Otowi Member of the Bandelier Tuff. The drainage area of the canyon is approximately 12.8 sq mi, of which TA-2 and TA-41 constitute only a small fraction. Los Alamos Canyon varies in depth from approximately 900 ft at Sierra de los Valles to 420 ft at State Route 4.

The Otowi Member of the Bandelier Tuff, typically outcropping within the lower canyon walls, consists of volcanic ash-flow deposits and comprises approximately 300 to 400 ft of the bedrock throughout the operable unit. A shallow alluvial aquifer occurs at several feet below land surface within Los Alamos Canyon, and a perched aquifer within the basalt and Puye Formation may occur at a depth of approximately 250 to 300 ft. Groundwater within the regional aquifer of the Santa Fe Group sediments lies at a depth of approximately 800 ft below Los Alamos Canyon. Groundwater within the regional aquifer flows to the east and partly discharges in springs and seeps along the Rio Grande (Chapter 2 of the IWP) (LANL 1992, 0768).

For the purposes of the RFI planning for OU 1098, existing topographic maps are generally adequate for Phase I investigation purposes. Aerial photographs taken over TA-2 and TA-41 in September 1991, however, would allow preparation of topographic maps with 2- to 7-ft contours which may be utilized in Phase II investigation. In this OU work plan, we propose that a topographic map with 2-ft resolution, based on these 1991 aerial photographs, standard surveying techniques, and field observations, be prepared to show surface drainage and deposition areas at TA-2 and TA-41 in preparation for Phase II activities, if they are shown to be required. This 2-ft contour topographic map would facilitate surface mapping, evaluation of characterization sampling analyses, and assessment of remedial alternatives as described in later chapters.

4.2 Climate

The climate at TA-2 and TA-41 is important because it can influence soil development (Birkeland 1984, 0239) and also affect the transport of contaminants in surface and subsurface environments. For example, the speed, frequency, direction, and stability of the wind can influence airborne transport of TA-2 and TA-41 contaminants while the form, frequency, intensity, and evaporation potential of precipitation strongly influence surface-water run-off and infiltration at TA-2 and TA-41.

Los Alamos County has a semiarid, temperate, mountain climate, as summarized in Chapter 2 of the IWP (LANL 1992, 0768) and discussed in detail

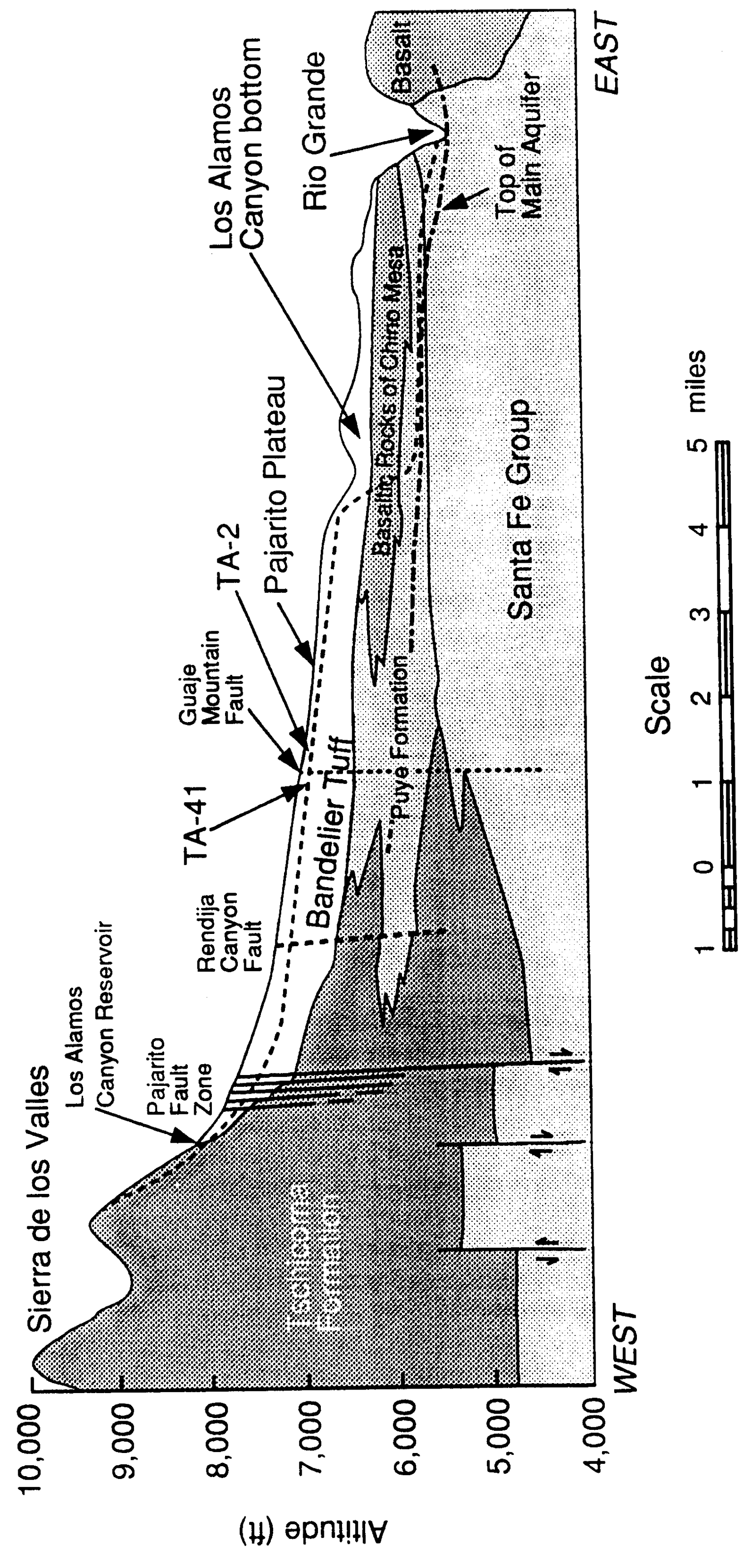


Figure 4.1-1 Geologic section showing the location of TA-2 and TA-41 with respect to stratigraphy and structure from the Sierra de los Valles across the Pajarito Plateau to the Rio Grande.

by Bowen (Bowen 1990, 0033). The East Gate station, one of four meteorological stations around the Laboratory site, is located 1.6 miles northeast of TA-2 and TA-41 and has provided data continuously since 1987. However, there are no meteorological stations within Los Alamos Canyon or other LANL canyons.

Surface winds measured at the East Gate are generally light, with strong winds often occurring in the spring. The predominant direction for all winds is from the south and southwest. These data imply that any airborne contaminants from TA-2 and TA-41 PRSs should be dispersed mainly toward the northern and eastern boundaries of the Laboratory and over the eastern portion of the townsite. As shown in Figure 4.2-1, 1989 wind speeds at the East Gate were less than 5.5 mph 38% of the time and greater than 11 mph 21% of the time (ESG 1990, 0497). While the prevailing winds on mesa tops provide information on the transport of airborne constituents once they have reached that elevation, conditions in the canyons may be quite different than those on the mesa tops. Thus transport of airborne contaminants within the canyon may follow a different pattern. A diurnal pattern of wind movement has been deduced from regular observations. During the day, the winds tend to blow easterly, whereas at night the wind movement is up-canyon or in a westerly direction. Shear winds have also been noted across the canyon.

The average annual precipitation at TA-2 and TA-41 is approximately 16 in/yr (ESG 1990, 0497). About 50% of the precipitation on the Pajarito Plateau occurs during brief, intense thunderstorms during July and August, often causing significant surface water run-off. The prevalence of short, intense precipitation events indicates that surface erosion, soil run-off, sediment run-off, and surface-water transport are potential mechanisms for the movement of surficial contaminants at this OU. About 20% of the precipitation occurs as snowfall in December, January, and February, and the remaining 30% is distributed over the other 7 months of the year.

4.3 Surface Deposits

This section discusses surface deposits at TA-2 and TA-41, the soils and sediments in Los Alamos Canyon, the soils in the canyon walls and bottoms, and past sediment sampling investigations at TA-2 and TA-41.

4.3.1 Surficial (Erosional) Deposits

Surficial (erosional) deposits at TA-2 and TA-41 consist mainly of alluvium, colluvium, and landslide deposits. Erosion at TA-2 and TA-41 occurs by the following mechanisms:

- Run-off in Los Alamos Canyon,
- Rockfall, landslide, debris flows, and colluvial shedding from the canyon walls,

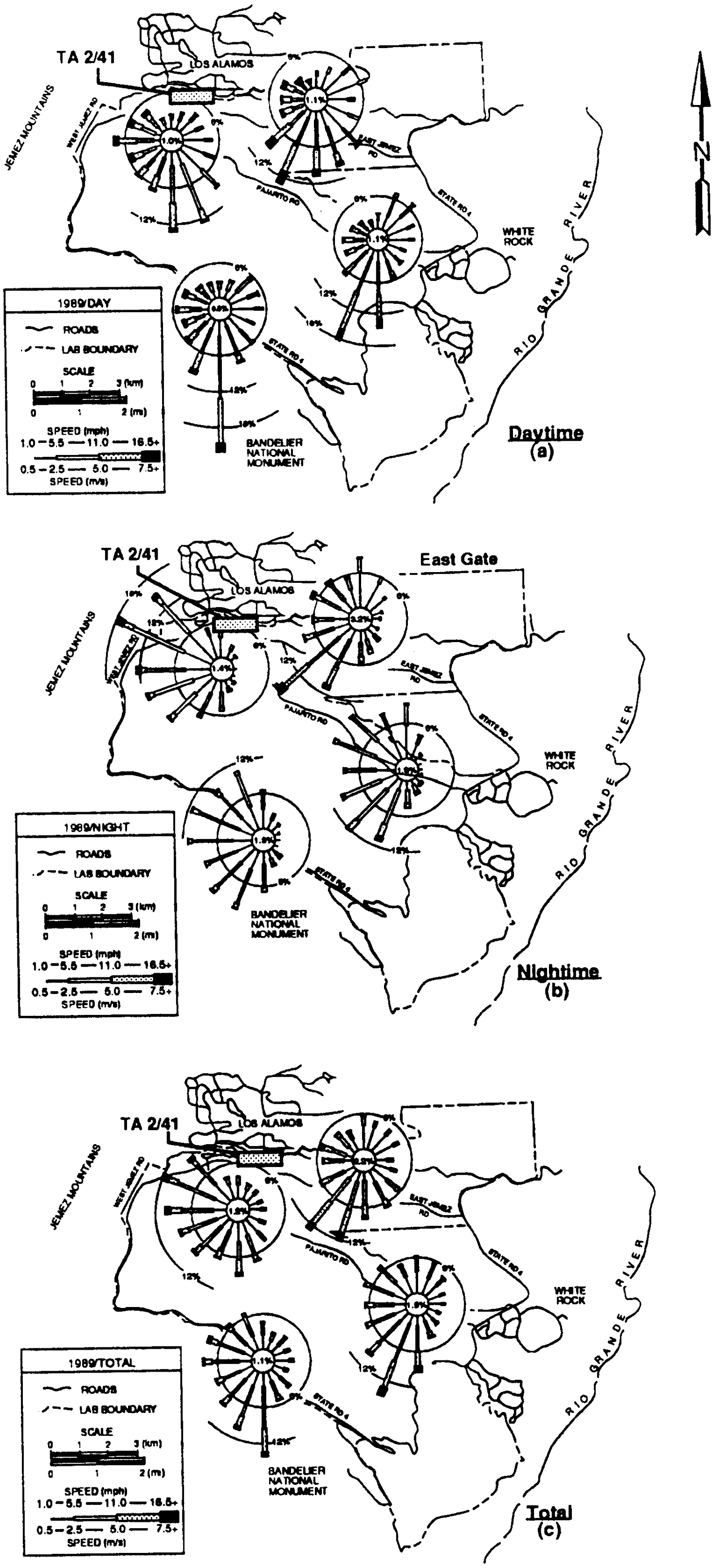


Figure 4.2-1 Wind roses at Laboratory stations during 1989 (from ESG 1990, 0497) .

- Wind transport, and
- Water transport.

An estimate of the rates of erosion and deposition, which includes these pathways of erosion, is essential to an assessment of potential operational safety hazards at TA-2 and TA-41, especially with respect to rockfall and landslides. However, erosion/deposition rates of mesa top soils, canyon sediments, and the Bandelier Tuff generally are not well understood (see Subsection 2.6. of the IWP). It appears that cliff-forming units are eroded predominantly by lateral cliff retreat and block spallation rather than by vertical incision. Variable erosion rates are to be expected, the rates depending on different factors including gradient, vegetation, and slope orientation (for example, north- versus south-facing slopes).

Mass wasting processes such as rockfall, especially within the Rendija Canyon and Guaje Mountain Fault zones, are considered potential threats to the integrity of TA-2 and TA-41 PRSs over the foreseeable future time frame (100 yr). Records for the last 4 decades indicate that, on average, TA-2, is invaded by one boulder of 300 or more pounds every 2 yr (McLin 1992a, 03-0010). This study also calculated a canyon retreat rate at this site of 2.5 cm/1000 yr. However, these low average rates are not relevant to massive cliff failure induced by a large seismic event or by other erosional processes. Fences designed to impede rock fall movement have been installed along portions of the cliff faces exposed north of TA-2 and TA-41. Additional fences are planned for these cliff faces in Los Alamos Canyon at TA-2 and TA-41.

Alluvial sands and gravels in Los Alamos Canyon are likely to be interbedded with fine-grained debris flows. Trenching in alluvium in Cabra Canyon, about 3 miles north of TA-2 and TA-41, revealed that the Holocene alluvial sequence was less than 6000 yr old and that three periods of channel migration and subsequent backfilling occurred since 4000 years ago (Gardner et al. 1990, 0639). Gardner et al. also reported a major unconformity in canyon-fill deposits from 6000 to greater than 700 000 yr old.

These observations are significant because drainages within the Laboratory boundaries may have been stripped of their unconsolidated sediment fill during extreme flood (and/or periodic scouring events) prior to 6000 years ago and partially stripped several times since then. This scour-and-fill cycling of canyon alluvium might have occurred in response to climatic variations. The possibility of a future scouring event obviously exists. For TA-2 and TA-41, such a scouring event could affect PRSs located within the stream channel, thus influencing sediment-contaminant transport by surface waters (Hakonson and Nyhan 1980, 0117). A comprehensive study of a major Pajarito Plateau watershed such as Los Alamos Canyon aimed at quantifying erosion rates, water budget, sediment sources and storage, and scour-and-fill cycles has never been performed.

For this RFI, existing data on erosional and depositional processes are not adequate because no detailed studies of this nature have been conducted in a site such as Los Alamos Canyon. A topographic map of erosion/deposition areas within OU 1098, to be prepared during Phase I activities as discussed earlier in Section 4.1, is important for evaluation of these processes during Phase II studies.

4.3.2 Los Alamos Canyon Soils and Sediments

Soils on the Pajarito Plateau were initially mapped and described by Nyhan et al. (1978, 0161) and are discussed in Chapter 2 of the IWP (LANL 1992, 0768). The soils were formed under a semiarid climate and are derived from alluvial fans, eolian processes, and chemical, biological, and physical weathering of the Bandelier Tuff. Figure 4.3-1 shows the distribution and designations of surface soils at TA-2 and TA-41.

The slopes between the mesa tops and canyon bottoms have been mapped as mostly steep rock outcrops consisting of about 90% bedrock outcrop and patches of shallow, undeveloped soils (Nyhan et al. 1978, 0161). Soils mapped in the vicinity of TA-2 and TA-41 are generally poorly developed and are designated as Typic Ustorthents-rock outcrop complex. This complex consists of deep, well-drained soils that weather from dacites and latites of the Tschicoma Formation (Nyhan et al. 1978, 0161). The surface layers of the Typic Ustorthents are generally a pale brown stony or gravelly sandy loam about 5 cm thick. The substratum is about 150 cm thick and generally consists of a very pale brown or light gray gravelly-loamy sand or sand. The Typic Ustorthents have moderate to very high permeability and a very low available water capacity.

Alluvium underlies Typic Ustorthents and consists of boulders, gravel, sand, silt, and clay. The alluvium is of variable thickness and is underlain by the Otowi Member of the Bandelier Tuff (Nyhan et al. 1978, 0161).

4.3.3 Previous TA-2 and TA-41 Sediment Sampling

In 1975, a program was initiated in which the sediments within Los Alamos Canyon, including TA-2 and TA-41, are sampled as part of the Laboratory-wide routine environmental surveillance program. The location of sediment stations in Los Alamos Canyon, including TA-2 and TA-41, is shown in Figure 4.3-2. Eleven sediment stations were established in Los Alamos Canyon from the Los Alamos Canyon Bridge to the Rio Grande at Otowi in 1975.

Analytical results from the annual sampling are available in 1975–1986 Laboratory memoranda and in annual Laboratory Environmental Surveillance reports since 1987. Tables 4.3-1 and 4.3-2 give results of analyses for several radionuclides in surface sediments collected within Los Alamos and DP canyons. These data cover the period from 1984 through 1988 and 1990. The samples were collected from eight locations as shown in Figure 4.3-2. The data are also presented in Figures 4.3-3 and 4.3-4, where concentrations and activities are plotted as a function of location in Los Alamos and DP canyons. These data indicate an increase relative to background in radionuclide content (cesium-137, plutonium-238, plutonium-239/240, and americium-241) of sediments downstream of TA-41 and TA-2. As most downstream sampling stations include inputs from both DP and Los Alamos Canyons, data on DP

TABLE 4.3-1

RADIONUCLIDE CONCENTRATIONS IN SEDIMENTS OF DP AND LOS ALAMOS CANYONS, 1984-1988[a]

Location	Tritium[b,d,e] (pCi/mL)	^{90}Sr[c,e] (pCi/g)	^{137}Cs[e] (pCi/g)	U[e] (µg/g)	^{238}Pu[e] (pCi/g)	$^{239/240}Pu$[e] (pCi/g)	^{241}Am[f] (pCi/g)
DP Canyon							
DPS-1	1.8 ± 3.6	5.9 ± 5.9	6.9 ± 6.6	3.4 ± 2.0	0.897 ± 1.236	2.731 ± 3.761	7.96 ± 13.41
DPS-4	2.4 ± 0.8	1.7 ± 0.3	11.1 ± 3.9	2.4 ±1.5	0.131 ± 0.048	0.418 ± 0.126	0.487 ± 0.419[g]
Los Alamos Canyon							
At Los Alamos bridge	2.4 ± 0.8	0.1 ± 0.2	0.2 ± 0.2	2.6 ± 1.1	0.000 ± 0.001	0.009 ± 0.015	0.289 ± 0.658
LAO-1	2.6 ± 0.8	0.2 ± 0.2	0.8 ± 0.8	2.8 ± 0.9	0.006 ± 0.009	0.317 ± 0.166	0.433 ± 0.812
GS-1	5.2 ± 1.2	0.5 ± 0.3	5.9 ± 5.5	4.0 ± 1.3	0.141 ± 0.107	0.695 ± 0.274	0.753 ± 0.880
LAO-3	2.6 ± 0.8	0.5 ± 0.4	2.3 ± 2.7	4.1 ± 4.5	0.030 ± 0.030	0.241 ± 0.126	0.394 ± 0.655
LAO-4.5	2.7 ± 0.8	0.7 ± 0.4	9.6 ± 10.6	3.7 ± 1.1	0.134 ± 0.113	0.689 ± 0.558	0.575 ± 2.054
At State Route-4	3.4 ± 0.8	0.5 ± 0.2	3.6 ± 3.0	3.1 ± 1.2	0.080 ± 0.038	0.426 ± 0.260	0.816 ± 0.837
Maximum Concentration	5.2 ± 1.2	5.9 ± 5.9	11.1 ± 3.9	4.1 ± 4.5	0.897 ± 1.236	2.731 ± 3.761	7.96 ± 13. 41
Background[h]	0.5 ± 0.3	0.23 ± 0.32	0.18 ± 0.13	2.6 ± 0.9	0.001 ± 0.003	0.005 ± 0.009	0.001 ± 0.003

[a]ESG data (1985-1989).

[b]Data from 1 yr (1984) only.

[c]Data from 4 yr (1984-1986, 1988).

[d]Measurement ± counting uncertainty.

[e]Mean of measurements ± standard deviation (X ± SD).

[f]Data for 4 yr (1984-1987).

[g]Data for 3 yr (1984-1986).

[h]Data from Myrick et al. (1981, 0413)

TABLE 4.3-2

RADIONUCLIDE CONCENTRATIONS IN SEDIMENTS OF DP AND LOS ALAMOS CANYONS, 1990

Location	^{3}H (pCi/g)	^{90}Sr[a] (pCi/g)	^{137}Cs[a] (pCi/g)	Total Uranium [a] (μg/g)	^{238}Pu[a] (pCi/g)	$^{239,240}Pu$[a] (pCi/g)	^{241}Am[a] (pCi/g)	Gross Gamma (counts/min/g)
Sediments from Effluent Release Areas								
DP-Los Alamos Canyons								
DP Canyon at DPS-1	—	—	0.30 ± 0.08	2.0 ± 0.2	0.003 ± 0.015	0.043 ± 0.012	0.002 ± 0.001	2.1 ± 0.4
DP Canyon at DPS-4	—	0.27 ± 0.37	0.25 ± 0.14	3.4 ± 0.3	0.002 ± 0.001	0.356 ± 0.017	0.007 ± 0.001	4.7 ± 0.6
Los Alamos Canyon at Bridge	—	0.54 ± 0.44	0.16 ± 0.07	2.2 ± 0.2	0.000 ± 0.001	0.003 ± 0.001	0.002 ± 0.001	2.3 ± 0.4
Los Alamos Canyon at LAO-1	—	0.02 ± 0.45	0.36 ± 0.16	4.5 ± 0.4	0.004 ± 0.001	0.467 ± 0.021	0.006 ± 0.002	4.8 ± 0.6
Los Alamos Canyon at GS-1	—	0.49 ± 0.94	1.8 ± 0.28	3.4 ± 0.4	0.017 ± 0.002	0.192 ± 0.009	0.103 ± 0.018	4.6 ± 0.6
Los Alamos Canyon at LAO-3	—	0.09 ± 0.50	0.20 ± 0.13	3.5 ± 0.4	0.001 ± 0.001	0.445 ± 0.021	0.011 ± 0.002	4.6 ± 0.6
Los Alamos Canyon at LAO-4.5	—	0.14 ± 0.25	2.5 ± 0.38	4.0 ± 0.4	0.019 ± 0.003	0.221 ± 0.011	0.138 ± 0.021	5.9 ± 0.7
Los Alamos Canyon at State Route 4	—	0.12 ± 0.24	1.5 ± 0.27	3.1 ± 0.3	0.008 ± 0.002	0.124 ± 0.008	0.062 ± 0.008	4.1 ± 0.6
Maximum Concentration		0.54 ± 0.44	2.5 ± 0.38	4.5 ± 0.4	0.19 ± 0.003	0.467 ± 0.021	0.370 ± 0.050	5.9 ± 0.7
Background [b]	0.5 ± 0.3	0.23 ± 0.32	0.18 ± 0.13	2.6 ± 0.9	0.001 ± 0.003	0.005 ± 0.009	0.001 ± 0.003	

[a] Mean of measurements ± standard deviation (X ± SD)

[b] Data from Myrick et al. (1981, 0413).

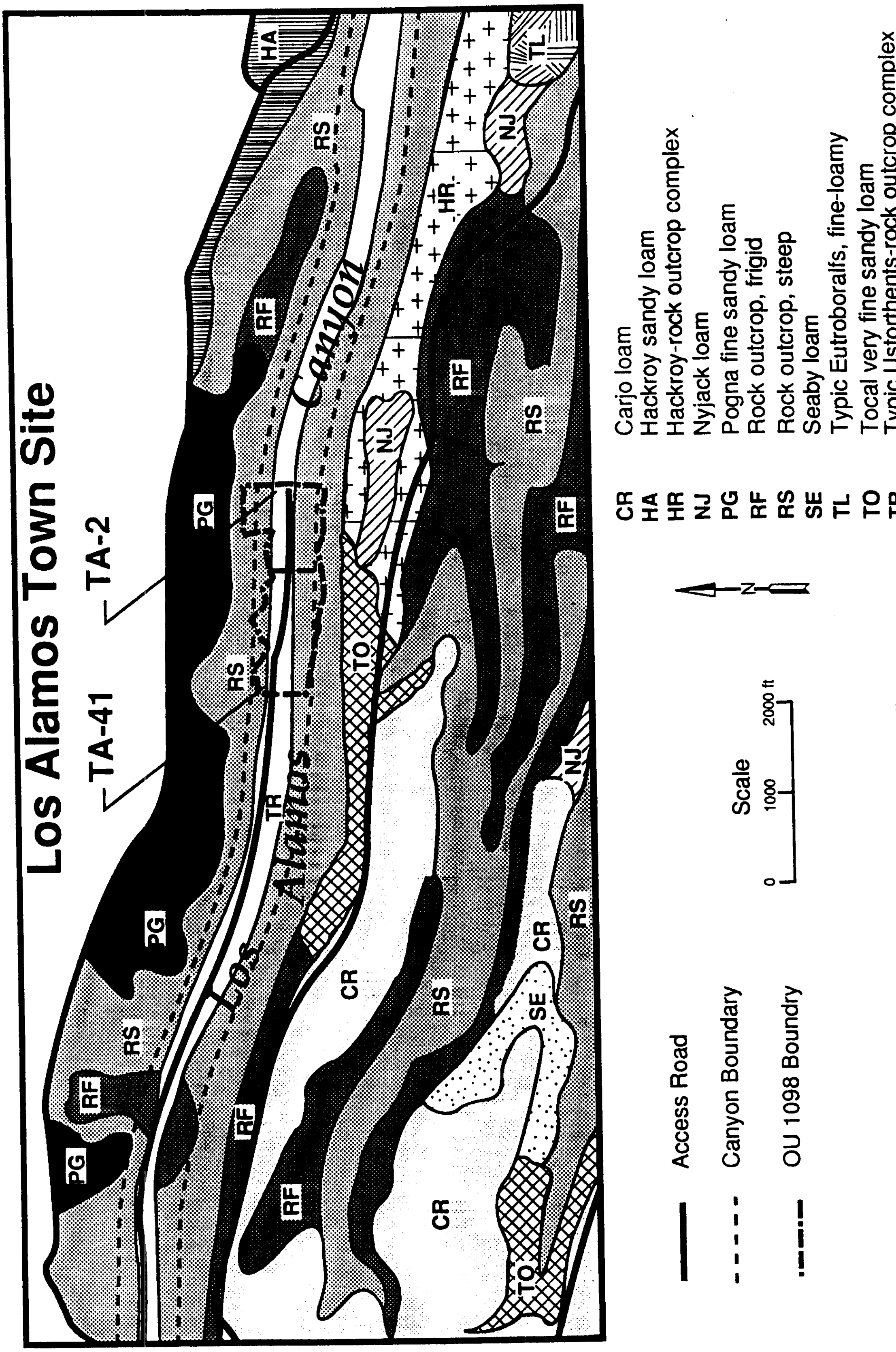


Figure 4.3-1 Soils map of Los Alamos Canyon and surrounding area (Nyhan et. al. 1978, 0161).

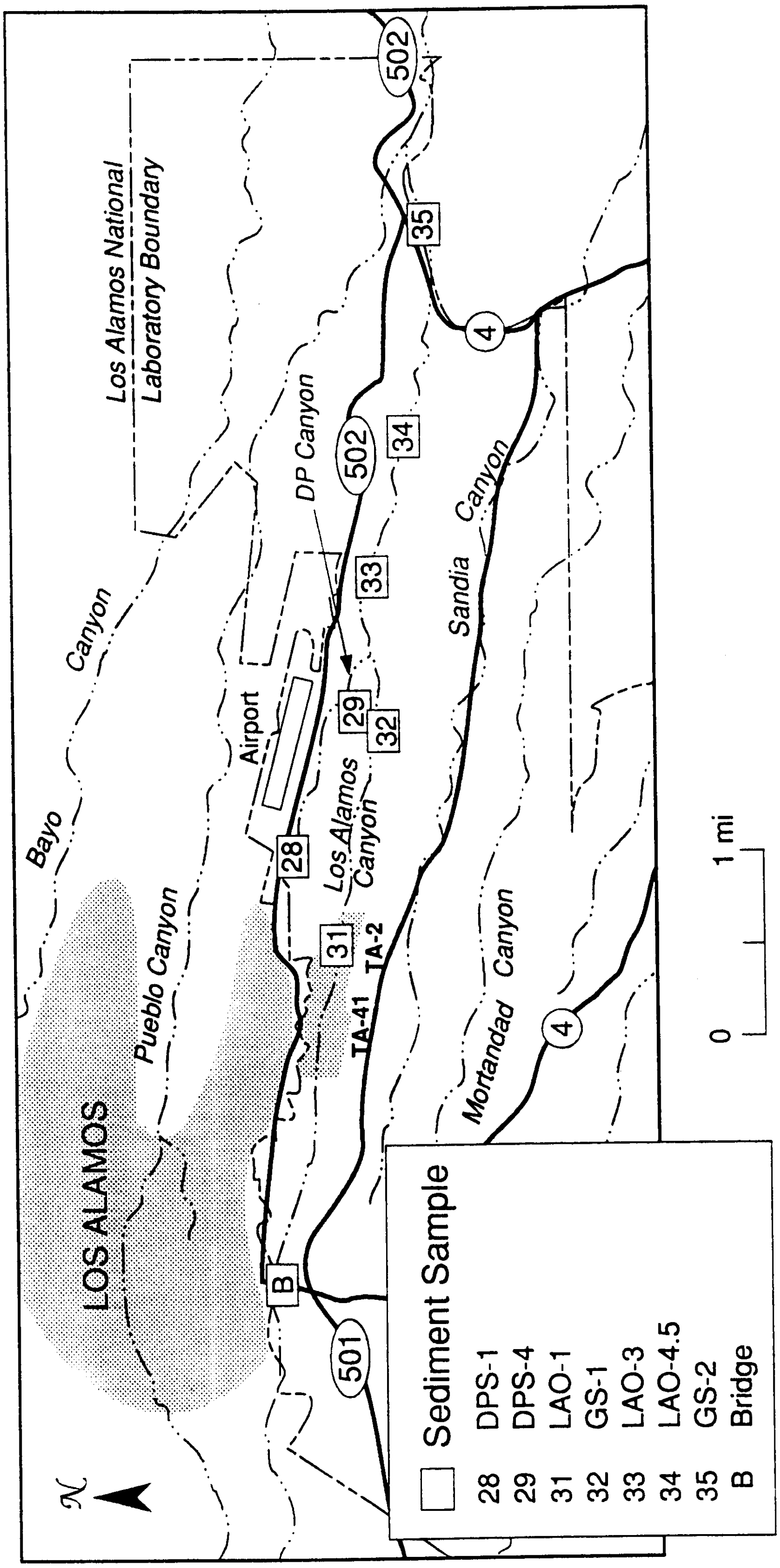


Figure 4.3-2 Sediment sampling locations in DP and Los Alamos Canyons. (ESG 1990, 0497).

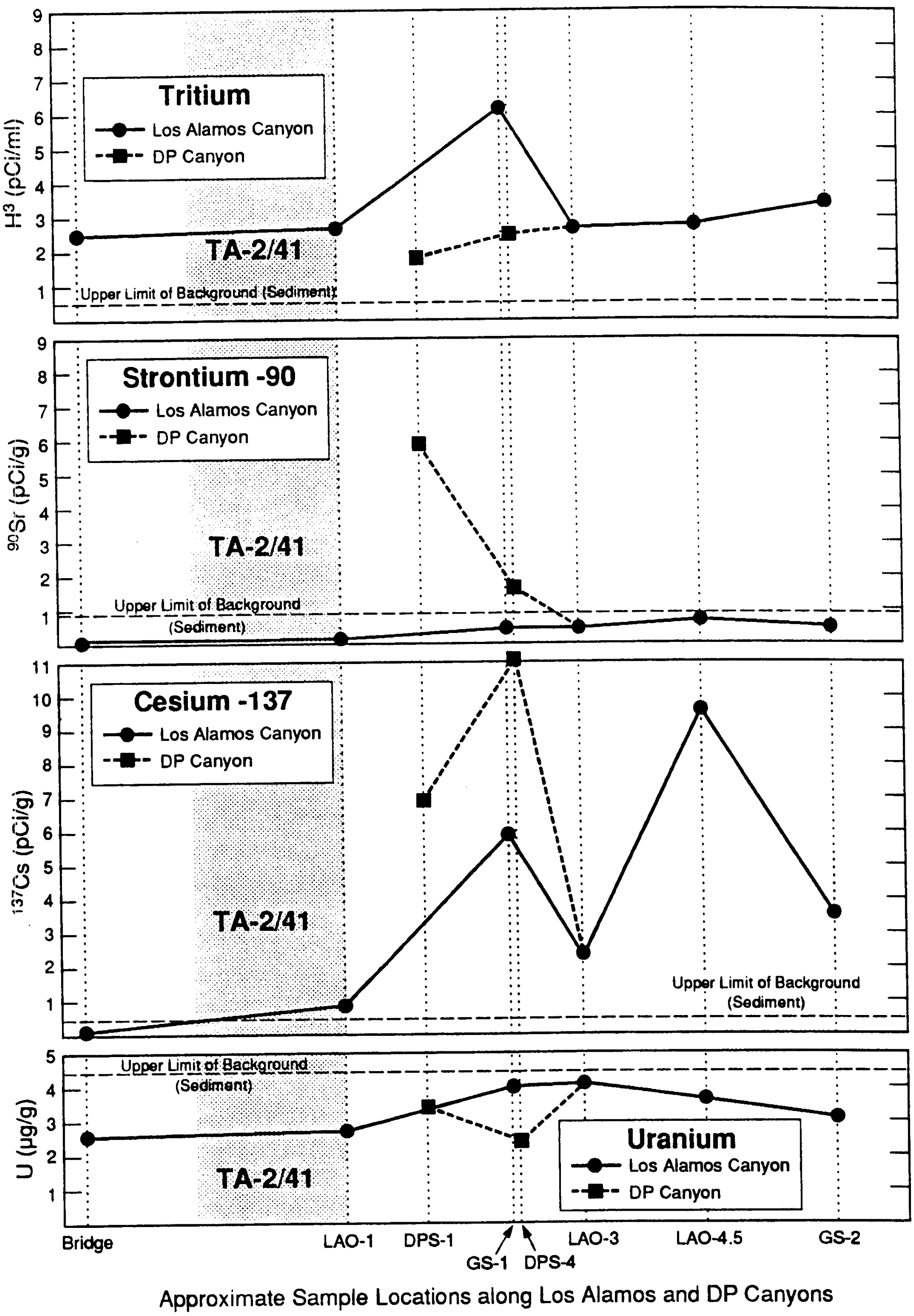


Figure 4.3-3 Graphs showing concentrations of tritium, strontium, cesium and uranium in sediment samples along Los Alamos and DP Canyons. Shaded area represents location of TA-2 and TA-41. Source of data: TA-21 work plan. Background values reported by Purtymun et al.(1987, 0211)

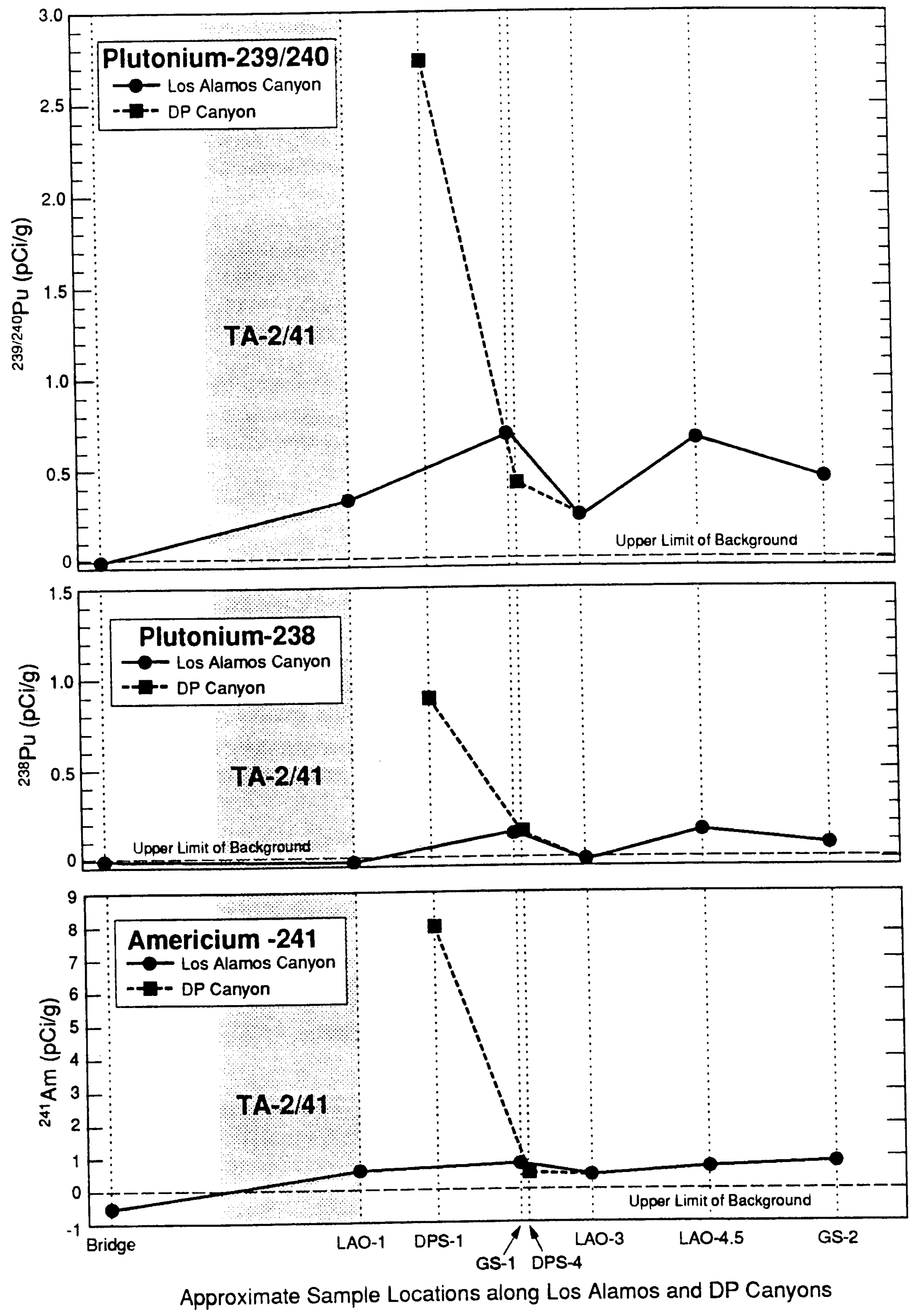


Figure 4.3-4 Graphs showing concentrations of plutonium-238, -239/240, and americium in sediment samples along Los Alamos and DP Canyons. Shaded area represents location of TA-2 and TA-41. Source of data: TA-21 work plan. Background values reported by Purtymun et al.(1987, 0211)

Canyon will help identify the contributions from areas outside of OU 1098, such as TA-21 which borders DP Canyon. (Technical Area-21 is the former site of a major plutonium fabrication and recovery facility before these functions were moved to present-day TA-55.) Stoker et al. (1981, 14-0045) reported that the plutonium inventory in the active channel of upper Los Alamos Canyon (west of State Route 4) varied seasonally and by location. Existing data indicate that strontium-90 does not exceed background levels in Los Alamos Canyon.

An inventory of plutonium in sediments in Acid, DP, and Los Alamos canyons indicated that only 8% of the plutonium was in the active channel; the remaining 92% was in the inactive channel and bank (Stoker et al. 1981,). A 1985 model (Lane et al. 1985, 0140) placed 33% of the inventory in the active channel and 67% in the inactive channel and on its banks.

In summary, the results generally indicate that radionuclide and metal contaminant levels are above regional background levels, with a few sampling locations showing levels at background. The sediment contaminant distribution is highly discontinuous and may be seasonally variable. Sections 6.1.3 and 6.1.4 discuss screening action levels, background levels, analytical detection limits, and analytical methods for OU 1098.

While the soil classifications of Nyhan et al. (1978, 0161) are adequate on a OU-wide basis, they do not provide all the hydrogeochemical parameters required to perform risk-assessment calculations to assess the local potential for erosional and solute transport of contaminants at TA-2 and TA-41. Geochemical parameters needed to assess erosional and solute transport include distribution coefficients (K_d), retardation factors (R_f), cation exchange capacities (CEC), percent organic carbon, porosity, and bulk density. More detailed soil characterization may be performed, including:

- Particle size distribution and surface area,
- Mineralogical properties including chemical composition, ion exchange capacity, pH, contaminant retardation factors for indicator contaminants, and clay and organic content,
- Hydraulic characteristics including permeability, and
- Vegetative cover characteristics.

Estimates of soil erosion by surface-water transport, the contaminant loading, and the available contaminant source term(s) in the soil and sediments of TA-2 and TA-41 will help assess the importance of this pathway.

4.4 Hydrology

The groundwater pathway is significant at OU 1098 because of the shallow depth to the alluvial aquifer. This is reinforced by past or continuing steady-state liquid discharges, from the inactive sewage treatment plant at TA-41, the cooling water system for OWR, and the surface water discharges from outfalls at TA-2 (see Chapter 7) within Los Alamos Canyon, and by the potential for significant infiltration given the presence of coarse-grained sediments within Los Alamos Canyon. Potential receptors include downgradient water users and wetland biota. Exposure points include springs, seeps, gaining streams, and pumping wells. Therefore, further subsurface characterization at TA-2 and TA-41 is very important.

Exposure to contaminants by receptors identified above further drives the need for a detailed saturated-zone study within Los Alamos Canyon. In addition, saturated zone studies will provide the information required for transport modeling over long time frames (Kearl et al. 1991, 0652).

4.4.1 Surface Hydrology

The most significant aspects of surface hydrology at TA-2 and TA-41 are contaminant dissolution/desorption, run-off, infiltration, and percolation. These mechanisms are the predominant ways in which contaminants could be mobilized and transported off-site (see Chapter 5). Aspects of surface hydrology relevant to PRS areas include:

- Areas and pathways of surface water run-off and sediment deposition,
- Rates of soil erosion, contaminant dissolution/desorption, transport, and sedimentation,
- Locations and sizes of areas of disturbed and undisturbed surface soils,
- Infiltration versus run-off relationships,
- Presence and effectiveness of sorptive media in retarding infiltration of water-borne contaminants, and
- Fate of infiltrating water.

4.4.1.1 Surface Water Run-Off

Run-off within Los Alamos Canyon carries contaminants into surface waters that can concentrate dispersed surficial contamination downstream (see Appendix A). Surface run-off from DP Mesa flows southeastward into Los Alamos Canyon. There is evidence for hydraulic connection of surface water and alluvial groundwater at TA-2 and TA-41 [see Section 2.6 of the IWP (LANL 1992, 0768) and ESG 1990, 0497]. A permanent alluvial aquifer is known in the upper and mid-reaches of the canyon (from Los Alamos Canyon Bridge to below the confluence with DP Canyon), where run-off and surface-water flow in Los Alamos Creek recharge the shallow alluvial system.

Pajarito Plateau run-off from summer storms typically reaches a maximum discharge in less than 2 hr and has a duration generally less than 24 hr (Purtymun et al. 1990, 0215). The high discharge rate sometimes observed carries large masses of suspended and bed sediments for long distances that may reach the Rio Grande.

Spring snowmelt occurs over a period of several weeks to several months at a low discharge rate (Purtymun et al. 1990, 0215). The long duration of flow from snowmelt results in the net movement of greater masses of suspended and bed sediments in canyons than that movement occurring during summer run-off events. However, proportionately more mesa top erosion occurs during intense summer run-off events than from snowmelt. Most infiltration occurs during the longer periods of snowmelt as a result of the length of the process and the lower rates of evaporation.

Release of water from Los Alamos Canyon Reservoir throughout most of the year results in nearly continuous surface water flow within Los Alamos Canyon near TA-2 and TA-41. A limited study of surface contaminant transport in Potrillo Canyon, 3 miles south of TA-2 and TA-41, was completed recently (Becker 1991, 0699). Experimental data from a rainfall simulator study at TA-51, approximately 3.5 miles southeast of TA-2 and TA-41 (Nyhan and Lane 1986, 0159), indicate that run-off is more than three times greater from an area of backfilled soil than from natural vegetated areas. Over very long time frames, surface erosion rates at TA-2 and TA-41 almost certainly will be great enough to affect the contaminated soil and alluvium at TA-2 and TA-41.

Surface-water quality data have been collected for about 25 yr within Los Alamos and DP canyons (ESG 1966 through 1990). In Los Alamos Canyon at and downstream of OU 1098, contaminant levels of tritium, cesium-137, plutonium-238, plutonium-238/240, and major cations and anions are generally above background levels observed at Los Alamos Canyon Reservoir. However, results of surface-water chemistry collected in DP Canyon, a drainage located north and east of TA-21 also show elevated levels of these contaminants, indicating that detectable contaminant transport from TA-21 has occurred. Additional surface-water stations will be considered during Los Alamos Canyon investigations at several localities within Los Alamos Canyon where perennial-flow conditions occur, especially upstream of the confluence of DP and Los Alamos canyons.

4.4.1.2 Flooding Potential in Los Alamos Canyon

The climate and topography, characteristic of the Laboratory, are conducive to short-term, high-intensity storm events and their associated run-off. Therefore, the Laboratory has recently performed an evaluation of the 100-yr storm events and resultant floodplain elevations for the watersheds that drain Pajarito Plateau and the Laboratory. This study was performed to satisfy the EPA's RCRA requirement to delineate the 100-yr floodplain elevations in order to assess potential impacts on LANL facilities.

The study documents the process of modeling precipitation and surface run-off for Pajarito Plateau, the flood routing simulation, and the presentation of the maps (McLin 1992b, 0825). For this study, the US Army Corps of Engineers' (COE's) computer-based Flood Hydrograph Package HEC-1 (Army Corps of Engineers and Dodson & Associates, Inc. 1990, 0235) and HEC-2 (Army Corps of Engineers and Dodson & Associates, Inc. 1982, 0236) were used to perform the floodplain hydrology simulations. Parameter inputs (e.g., precipitation, surface run-off, and initial soil moisture content) were selected to represent a "worst-case" scenario to present a conservative estimate of a 100-yr flood event in Los Alamos Canyon (McLin, 1992b, 03-0010). The storm event modeled for the canyon was a 100-yr, 6-h storm.

The peak flow calculated for a 100-yr storm event in Los Alamos Canyon is 26 m^3/sec (902 ft^3/sec) for a drainage area of approximately 21 sq mi, in comparison to 1 m^3/sec (24 ft^3/sec) and 9 m^3/sec (300 ft^3/sec) for a 2-yr and 10-yr event, respectively (DOE 1979, 0051). Figure 4.4-1 is a map developed for the 100-yr event in proximity to TA-2 and TA-41. These data indicate that flooding of Laboratory structures will be confined to TA-41, and that the TA-41 office building immediately adjacent to the creek would be flooded between 5 and 10 ft deep. These data also indicate that PRSs at TA-41 and possibly TA-2 would be affected by the 100-yr flood event. Appendix D contains a detailed map of a 100-yr storm for Los Alamos Canyon. Estimated velocities for surface water discharge in the modeled drainage range from approximately 3 ft/sec to a high of 7.4 ft/sec. Revised input data for this model will be assessed to evaluate the impacts of flooding on potential corrective measures for the PRSs during Phase I and Phase II investigations.

4.4.1.3 Surface Water Infiltration

Surface-water infiltration provides the mechanism by which contaminants dissolve or desorb and migrate into soils and alluvium, and allows contaminants to reach the alluvial aquifer. Surface water infiltration pathways at TA-2 and TA-41 include the following:

- Native or disturbed soils,
- Unconsolidated alluvium,
- Bandelier Tuff,
- Faults and fracture systems, and
- Monitor wells.

A recent study (Stoker et al. 1991, 0715) , of Mortandad Canyon [(located south of Los Alamos Canyon) (see Figure 4.4-2)] concludes that Laboratory effluents have migrated downward at least 200 ft vertically beneath the canyon bottom. Significant downward movement may similarly occur at TA-2 and TA-41 because of two key factors. First, most of the alluvium is saturated because of the near-perennial surface flow within Los Alamos Canyon. In turn, moisture levels in the underlying Bandelier Tuff may be sufficiently high to allow for water movement through the tuff. Moisture level data may be collected during Phase I and Phase II investigations to address this transport scenario. Second, the Rendija Canyon and Guaje Mountain faults occur within TA-41 and TA-2 (Vaniman and Wohletz 1990, 0541), respectively, which may be conduits for downward fluid flow.

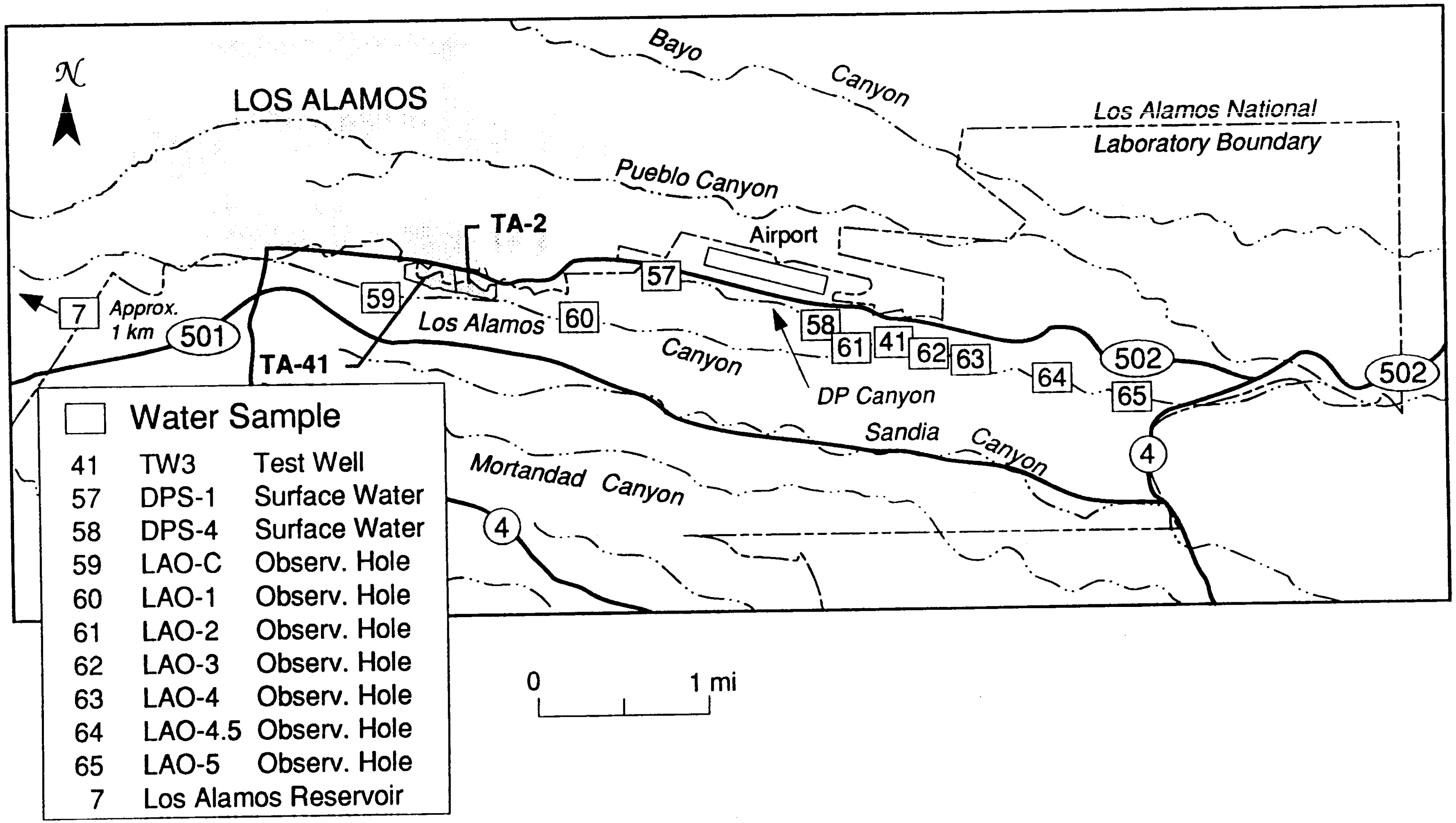


Figure 4.4-2 Surface water and groundwater sampling locations in DP and Los Alamos canyons (ESG 1990, 0497).

4.4.2 Vadose Zone Hydrology (Otowi Member)

Understanding of the vadose zone within the Otowi Member of the Bandelier Tuff beneath TA-2 and TA-41 is important because the vadose zone encompasses both potential secondary barriers and conduits for the movement of liquids originating from the PRSs and migrating through the alluvium. Features of the unsaturated tuff relevant to contaminant transport (Kearl et at. 1986, 0135) which may be considered during Phase II investigations, include the following:

- Physical properties (density, porosity, specific gravity),
- Geohydrologic properties (saturated and unsaturated permeabilities, conductivities, and moisture characteristic curves),
- Fractures and joints (frequency, orientation, degree of interconnectedness, and filling materials),
- Flow paths or barriers at unit contacts or paleosurfaces,
- Geochemical properties (specific surface area, ion exchange capacity, retardation factors, and mineralogy), and
- Depth to groundwater.

The significance of natural fracture systems at TA-2 and TA-41, especially at the Guaje Mountain and Rendija Canyon faults, may need to be evaluated during Phase II activities (see Section 7.1). The lateral variability of potential permeable zones such as cooling fractures, and fault zones, needs further evaluation.

4.4.3 Saturated Zone Hydrology

Section 4.4.3 presents a discussion on saturated zone hydrology for the alluvial aquifer, basalt-Puye Formation, and Santa Fe Group sediments within Los Alamos Canyon. Contaminants present in OU 1098 and Los Alamos Canyon are dispersed in the alluvial aquifer and potentially could migrate downward to the basalt-Puye Formation and Santa Fe Group.

4.4.3.1 Alluvial Aquifer

Surface-water infiltration creates a saturated zone in the alluvium of Los Alamos Canyon within the Laboratory boundary [see Subsection 2.6.4 of the IWP (LANL 1992, 0768)]. Surface water infiltrates through the alluvium, and downward movement continues into the Otowi Member of the Bandelier Tuff. Partial depletion by evapotranspiration and movement into the underlying geologic formations control the size and depth of the alluvial aquifer.

The saturated zone hydrology at TA-2 and TA-41 is dominated by saturated flow conditions for the alluvial aquifer. The saturated thickness of the alluvial aquifer varies throughout the year, being greatest in the spring and summer when recharge is maximal. The saturated thickness of the alluvial aquifer varies from a few feet to approximately 20 ft (ESG 1990, 0497).

The alluvial aquifer in Los Alamos Canyon extends from its upper reaches near the Los Alamos Canyon Reservoir to below the confluence with DP Canyon at TA-21. It is recharged by infiltration from the drainage channel most of the year. Water levels decline in the winter when run-off is at a minimum (LANL 1992, 0768). Contaminants in soil and surface water enter the alluvial aquifer and may migrate downgradient at different rates due to adsorption and precipitation reactions. This shallow aquifer is of interest because of the following issues:

- Contaminated surface water recharging an alluvial aquifer may be stored in the canyon system and be available for uptake by the biota and wetland inhabitants locally or at downgradient discharge points (Appendix C of IWP)
- Contaminated groundwater moves downgradient and discharges to springs and streams, and
- The alluvial aquifer is a zone for infiltration into the underlying Bandelier Tuff and is a source of water that could move toward the much deeper (main) aquifer within the Santa Fe Group (especially within the Guaje Canyon and Rendija Mountain fault zones).

Alluvial groundwater flow within Los Alamos Canyon is expected to be rapid due to the coarse-grained texture of the alluvium. An average hydraulic conductivity value obtained from nine slug tests conducted by the ESG group (EM-8) personnel is 4.73×10^{-4} ft/sec (range, 4.78×10^{-5} to 1.31×10^{-3} ft/sec). The average rate of groundwater movement in the alluvium can be determined by the following equation (Freeze and Cherry 1979, 0845):

$$V = \frac{K\,dh}{Ne\,dl}$$

$$V = \frac{(4.73 \times 10^{-4}\ \text{ft/sec})\ (0.027\ \text{ft/ft})}{0.35}$$

$V = 3.65 \times 10^{-5}$ ft/sec or 1150 ft/yr

where V = velocity (L/t),

K = hydraulic conductivity (L/t)

$\frac{dh}{dl}$ = hydraulic gradient (L/L), and

Ne = effective porosity (L^3/L^3).

The hydraulic gradient was determined from the slope of the creek channel, whereas the effective porosity was an assumed value of 0.35.

The alluvial aquifer in Los Alamos Canyon is monitored by several shallow wells. The monitor well locations are shown in Figure 4.4-2, as described in Appendix E of this work plan, Section 2.6.4.4.2, and Appendix M of the IWP.

Results of annual chemical analyses of the shallow alluvial aquifer in Los Alamos Canyon are shown in Figures 4.4-3 through 4.4-6. Tritium activities are below detection limits at LAO-C, but increase immediately downgradient of TA-2 and fluctuate in activity further downgradient (ESG 1990, 0497). Tritium levels at LAO-1 (eastern boundary of TA-2) are highest in the 1990 ESG report (35000 pCi/L), suggesting an active source of tritium from OU 1098 (Figures 4.4-3 and 4.4-3A). Elevated tritium activities above background, near TA-2 and TA-41, probably are a result of previous and/or existing discharges at TA-2 (see Chapters 3 and 7).

Releases of tritium resulted from a leak in the primary cooling water system at OWR. The leak occurred from a break in a weld seam in a section of the delay line running from building TA-2-1 to the surge tank. This release was discovered in January 1993 and was within the Guaje Mountain fault zone. Tritium was leaking from the delay line at a rate of up to 70 gallons per day until March 1993 when the cooling water was drained from this line. Typical concentrations opf tritium in the cooling water ranged from 15.7 x 10^6 to 20.2 x 10^6 pCi/L.

Upgradient activities of strontium-90 and cesium-137 in the alluvial aquifer (LAO-C) are 0.6 and 270 pCi/L, respectively (Figures 4.4-3 and 4.4-3B). Activities of cesium-137 are the highest in the 1990 ESG report from 1984 through 1990 (Figure 4.4-3B). Strontium-90 activities increase downgradient to monitor well LAO-2 and decrease in monitor wells LAO-3, LAO-4, and LAO-4.5 (Figure 4.4-3 and 4.4-3C). Thermochemical calculations using the computer program PHREEQE (Parkhurst et al. 1980) suggest that strontium is stable as Sr^{2+}, which would undergo cation exchange (Rai and Zachara 1984, 0880) and may in turn account for the downgradient decrease in Sr-90.

Total dissolved solids (TDS) content increases downgradient from monitor well LAO-C (Figure 4.4-4). A sharp decrease in TDS occurs between monitor wells LAO-3 and LAO-4, which may be the result of mineral precipitation, groundwater chemistry of the Puye Formation, and possible dilution due to higher transmissive zones within the alluvial aquifer.

Uranium concentrations are generally within the microgram per liter range; however, elevated concentrations apparently occur in some samples (LAO-2, LAO-3) taken from the monitor wells (Figure 4.4-5).

Concentrations of several trace elements, reported only in the 1990 ESG report, are shown in Figure 4.4-6. Elevated concentrations of iron, manganese, and aluminum occur in groundwater samples obtained from LAO-C. These data suggest that an additional monitor well may be needed west of LAO-C to establish more representative background conditions and to better define source terms within Los Alamos Canyon.

Table 4.4-2 summarizes DOE's derived concentration guides for public dose for several radionuclides of interest at OU 1098 for the alluvial aquifer. Concentrations of tritium, strontium-90, and cesium-137 in some wells exceed DOE's calculated guides for drinking water systems.

Although the groundwater flow rate is substantial, a complete flushing of contaminants within the alluvium has not occurred (see Figures 4.4-3 through 4.4-6). The chemical data suggest that a significant inventory of contaminants

TABLE 4.4-1
SUMMARY OF TRITIUM ACTIVITIES WITHIN ALLUVIAL GROUNDWATER
LOS ALAMOS CANYON (units in pCi/L)

	MONITOR WELLS				
DATE	LAO - C	LAO - 1	LAO - 2	LAO - 3	LAO - 4
9/29/92	400 ± 300	9,300 ± 900	1,200 ± 300	1,000 ± 300	1,600 ± 400
2/02/93	100 ± 300	25,000 ± 200	—	700 ± 300	—
2/12/93	300 ± 300	28,000 ± 200	29,000 ± 200	700 ± 300	—
2/19/93	100 ± 300	12,000 ± 100	—	400 ± 400	—
2/25/93	400 ± 300	8,000 ± 100	—	—	—
2/26/93	—	31,000 ± 200	—	—	—
3/04/93	—	29,000 ± 200	—	—	—
3/05/93	—	29,000 ± 200	—	—	—
3/08/93	3,200 ± 500	26,000 ± 200	—	1,700 ± 400	—
3/09/93	—	25,000 ± 200	—	—	—
3/10/93	—	23,000 ± 200	—	—	—
3/11/93	—	23,000 ± 200	—	—	—
3/12/93	—	21,000 ± 200	—	—	—

All analyses performed by EM Division; denotes not determined. See Figure 4.4-2 for monitor well locations.

TABLE 4.4-2

DOE's CALCULATED GUIDES FOR PUBLIC DOSE FOR WATER

Nuclide	Calculated Guides for Drinking Water (pCi/L)
Hydrogen - 3 (Tritium)	20,000
Strontium - 90[a]	40
Cesium - 137	120
Uranium - 234	20
Uranium - 235	24
Uranium - 238	24
Plutonium - 238	1.6
Plutonium - 239[a]	1.2
Plutonium - 240	1.2
Americium - 241	1.2
	(mg/L)
Natural Uranium	0.03

[a]Guides for plutonium-239 and strontium-90 are the most appropriate to use for gross alpha and gross beta, respectively.

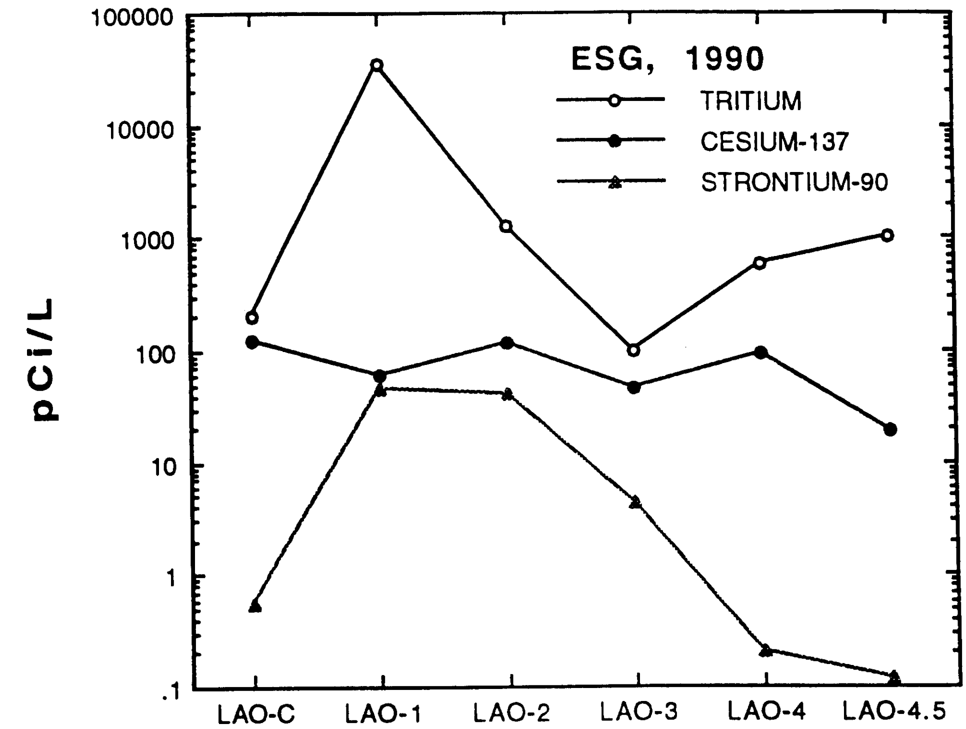


FIGURE 4.4-3, ALLUVIAL WELLS, LOS ALAMOS CANYON

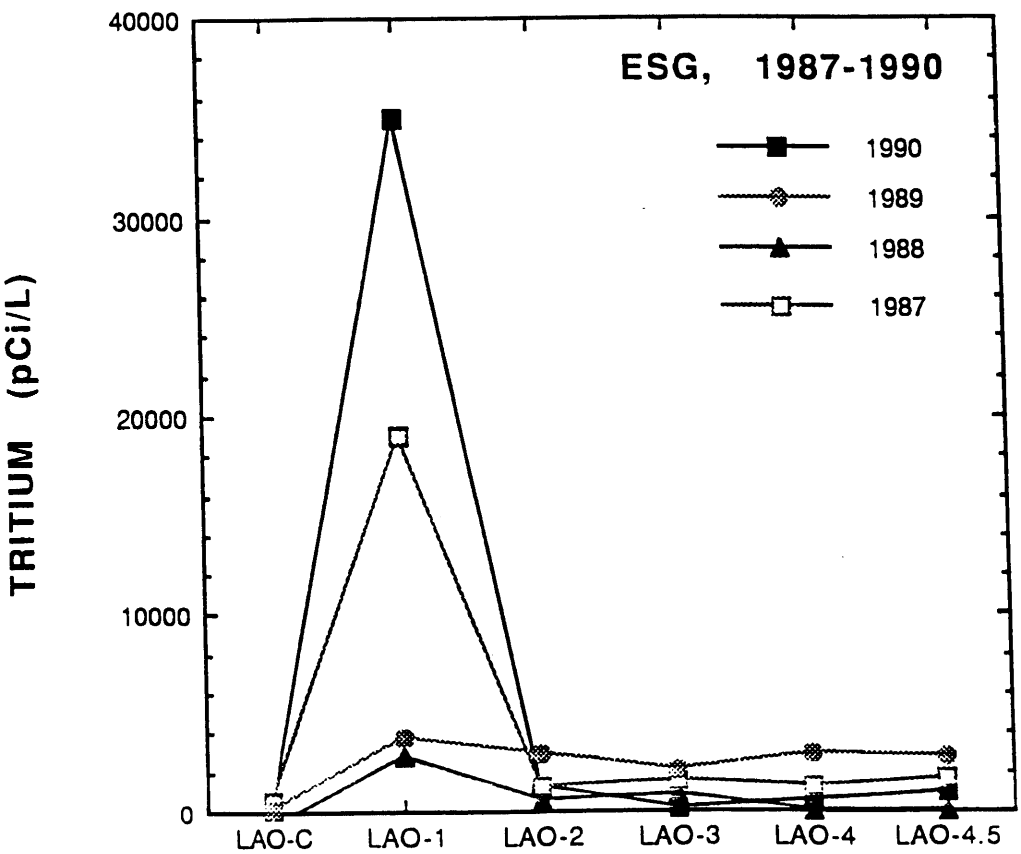


FIGURE 4.4-3A, ALLUVIAL WELLS, LOS ALAMOS CANYON

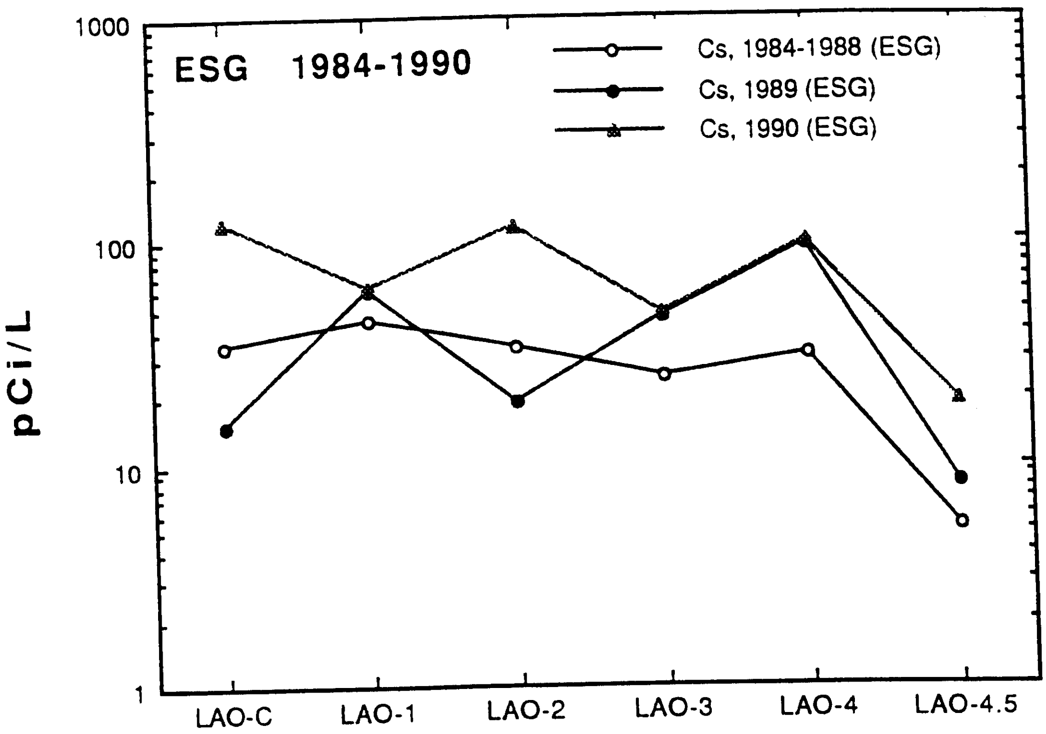


FIGURE 4.4-3B, ALLUVIAL WELLS, LOS ALAMOS CANYON

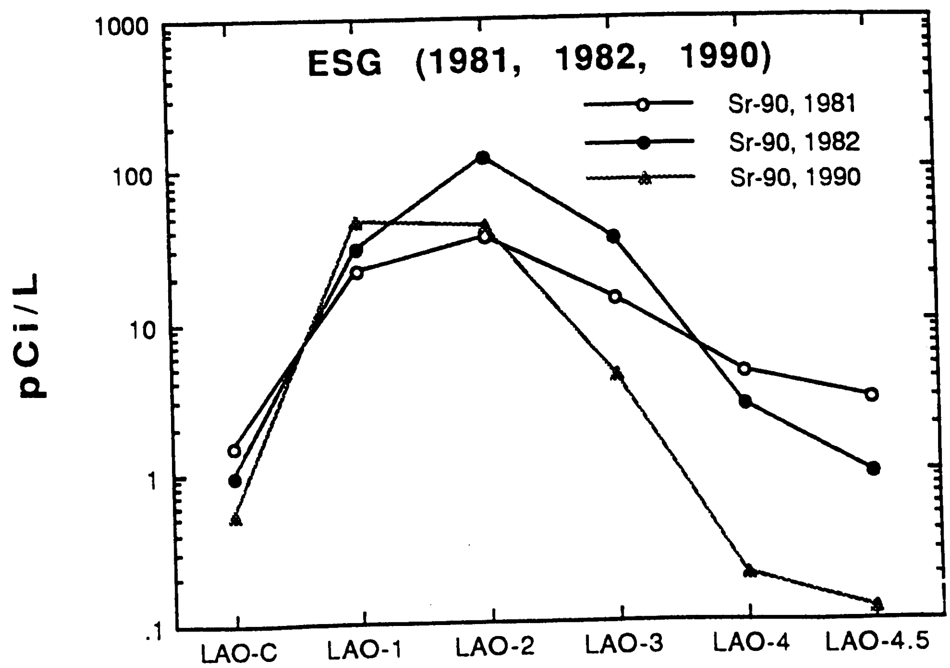


FIGURE 4.4-3C, ALLUVIAL WELLS, LOS ALAMOS CANYON

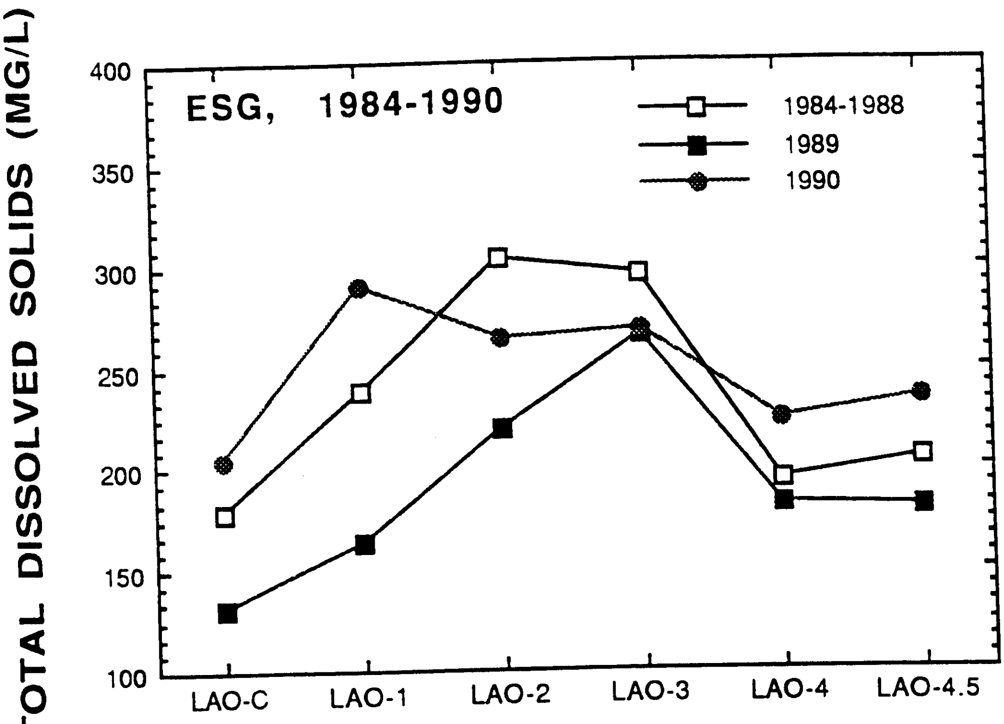


FIGURE 4.4-4, ALLUVIAL WELLS, LOS ALAMOS CANYON

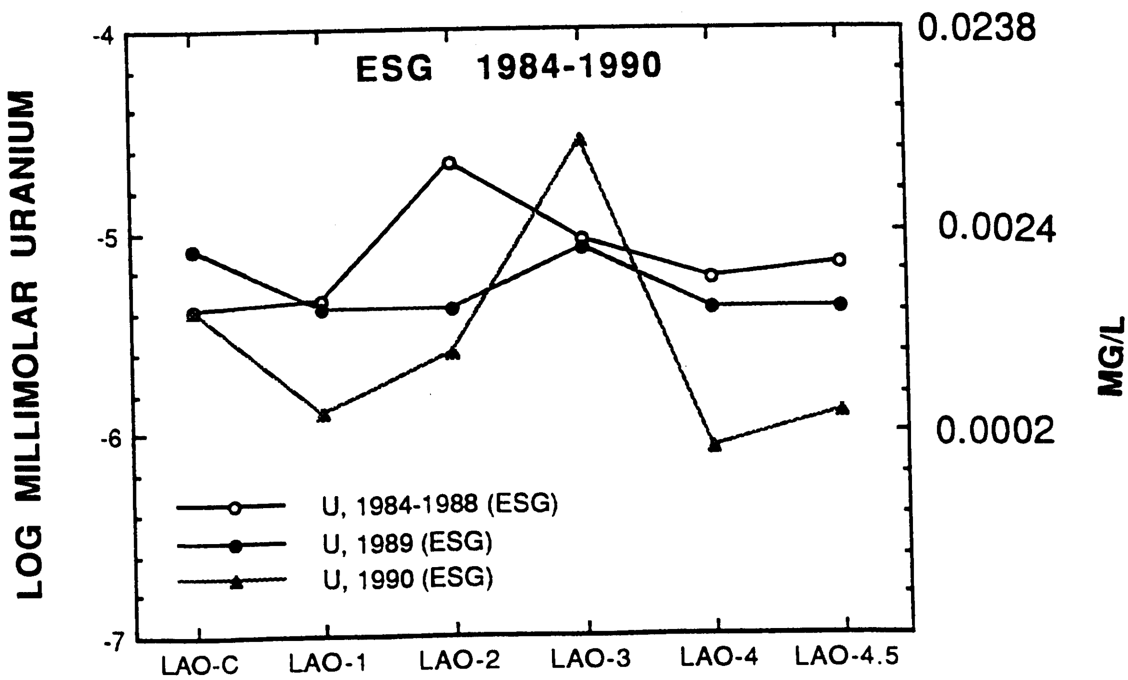


FIGURE 4.4-5, ALLUVIAL WELLS, LOS ALAMOS CANYON

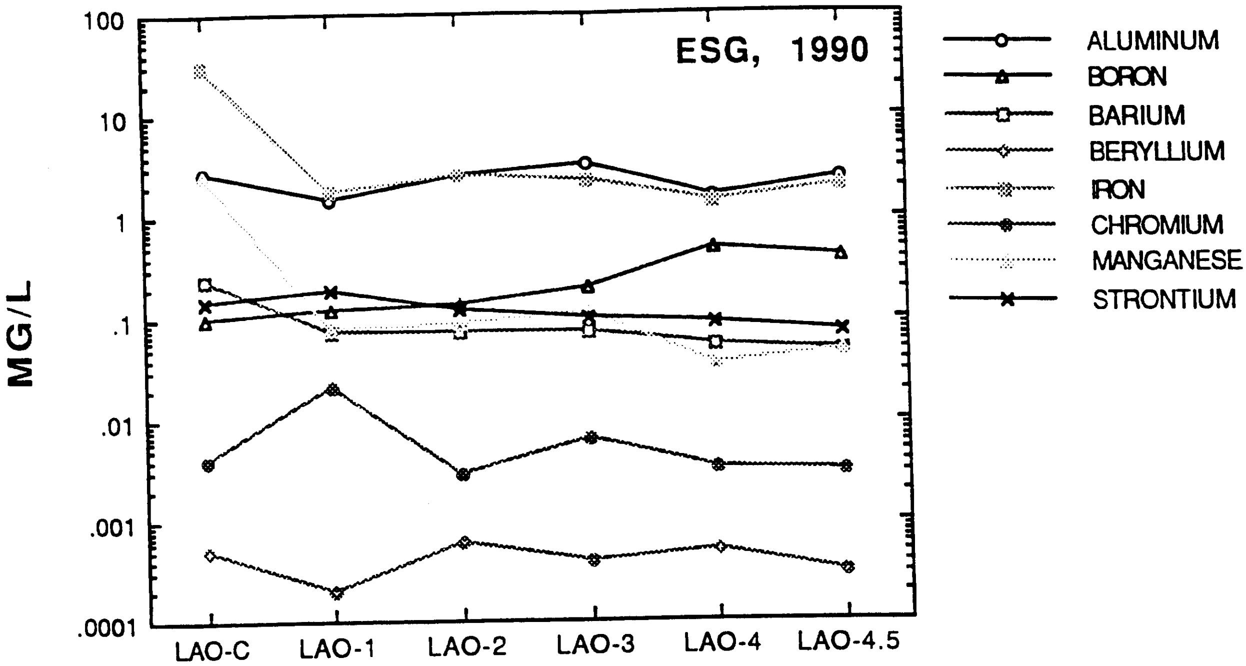


FIGURE 4.4-6, ALLUVIAL WELLS, LOS ALAMOS CANYON

remains in the sediments and groundwater at TA-2, TA-41, and possibly from other undefined sources in Los Alamos Canyon. Trends in the data suggest that there is possible ongoing or continuous releases from the source terms. Baseline sampling and PRS-specific sampling discussed in Chapter 7 of this work plan address quantifying contaminant uptake on soil/sediment surfaces.

Documented contamination of the alluvial aquifer (ESG 1990, 0497) indicates that more detailed groundwater characterization of Los Alamos Canyon near TA-2 and TA-41 is needed during the Phase I RFI investigations. Possibly as part of Framework studies, an upgradient characterization well should be placed west of LAO-C, near the dirt road leading to the Los Alamos Canyon Reservoir, because an unknown source may be affecting the "upgradient" analyte concentrations in samples obtained from LAO-C. Groundwater samples should be taken quarterly to establish water-quality trends depending on the amount of recharge from surface water.

4.4.3.2 Perched Aquifer within Basalt-Puye Formation

Perched-water systems occur in the conglomerates and basalts beneath the alluvium in portions of Pueblo, Los Alamos, and Sandia canyons (LANL 1992, 0768). These systems occur at depths less than 300 ft near this OU, but it is unknown whether the perched water immediately underlies the OU. Perched water 1 mile northwest of the OU is found at depths of 117 ft in test well 2A within the middle reach of Pueblo Canyon, and about 253 ft in Otowi 4 (Figure 4.4-7) within the middle reach of Los Alamos Canyon (Purtymun and Stoker 1988, 0205). A clay layer 5- to 10-ft-thick in the upper fanglomerate layer of the Puye Formation may be responsible for the perching.

4.4.3.3 Groundwater within the Santa Fe Group

The deep groundwater beneath TA-2 and TA-41 is part of the only aquifer in the Los Alamos area with water sufficient for municipal and industrial supplies (Purtymun 1984, 0196; Griggs and Hem 1964, 0313). The groundwater pathway potentially is important at this OU because of the potential for contaminant migration and recharge through the Otowi Member and underlying sediments to the groundwater within the Santa Fe Group. Figure 4.4-8 shows generalized contours of the top of the main aquifer beneath TA-2 and TA-41. Figure 4.4-9 shows TA-2 and TA-41 surface water and groundwater sampling locations in relation to stations elsewhere at the Laboratory.

The top of the saturated zone for the main aquifer occurs approximately 800 ft below the surface of Los Alamos Canyon at deep test well TW-3 (Figure 4.4-8) and supply well Otowi-4 located below the confluence of DP and Los Alamos canyons at the east end of TA-21. About 150 ft of this vertical distance is in the Otowi Member of the Bandelier Tuff. Past hydrologic characterization of the Bandelier Tuff has concentrated on the top 100 ft at most Laboratory study sites.

Presence of the Rendija Canyon and Guaje Mountain faults within OU 1098 represent potential recharge zones to the perched and main aquifers. Field investigations should be conducted to determine the extent of recharge or flux

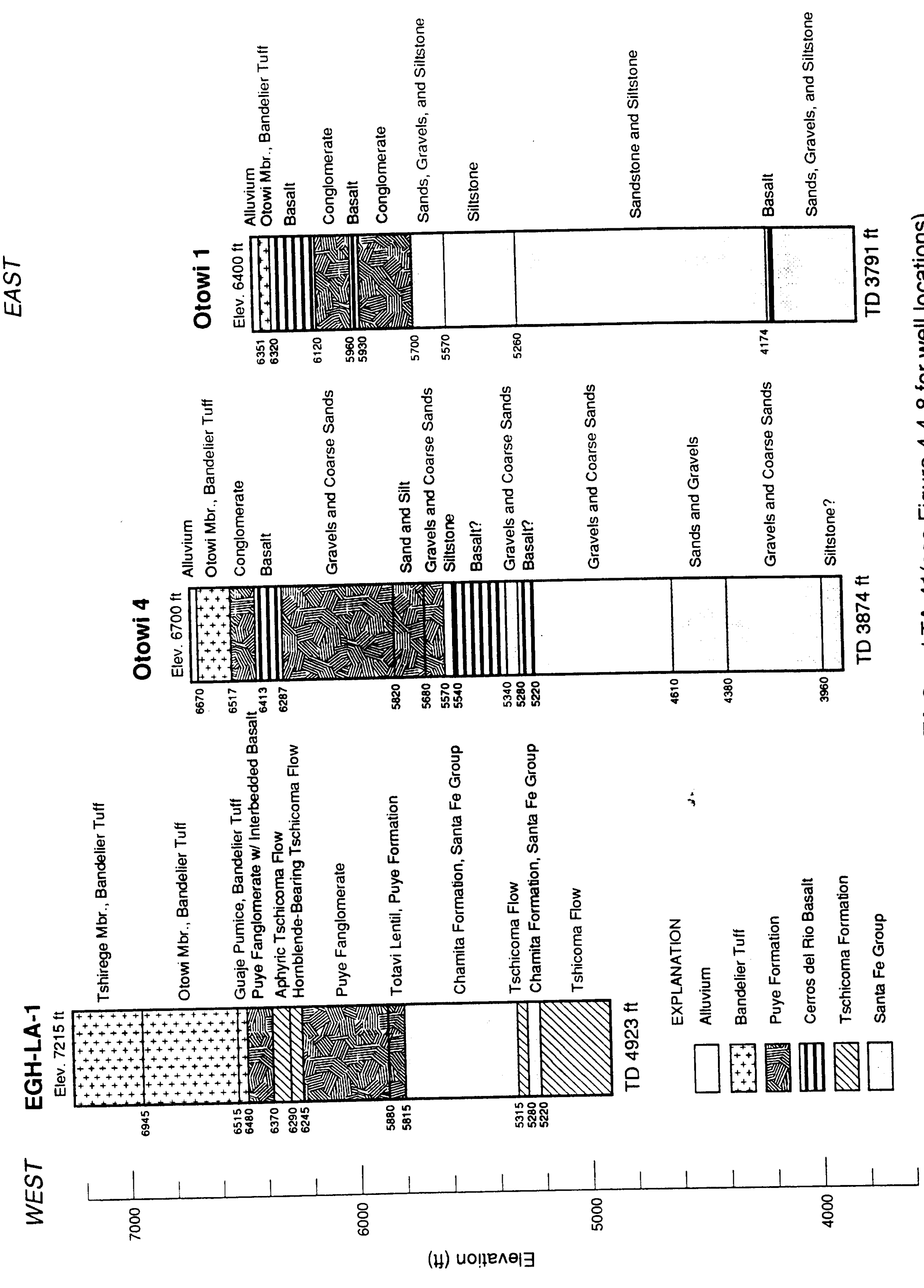


Figure 4.4-7 Lithologic logs for deep wells near TA-2 and TA-41 (see Figure 4.4-8 for well locations). Source of data: TA-21 work plan.

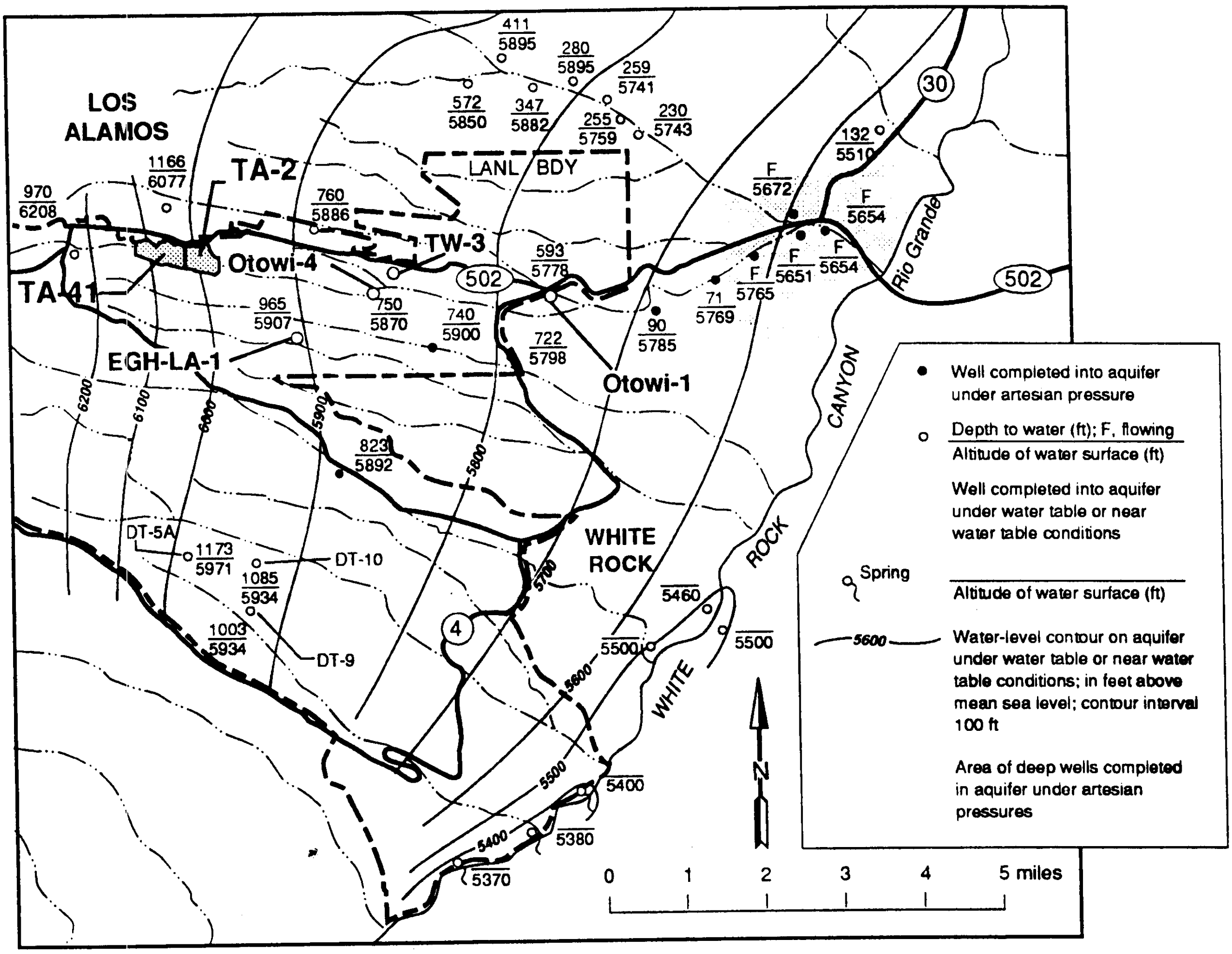


Figure 4.4-8 Generalized contours on top of the main aquifer (adapted from Purtymun and Johansen 1974, 0199).

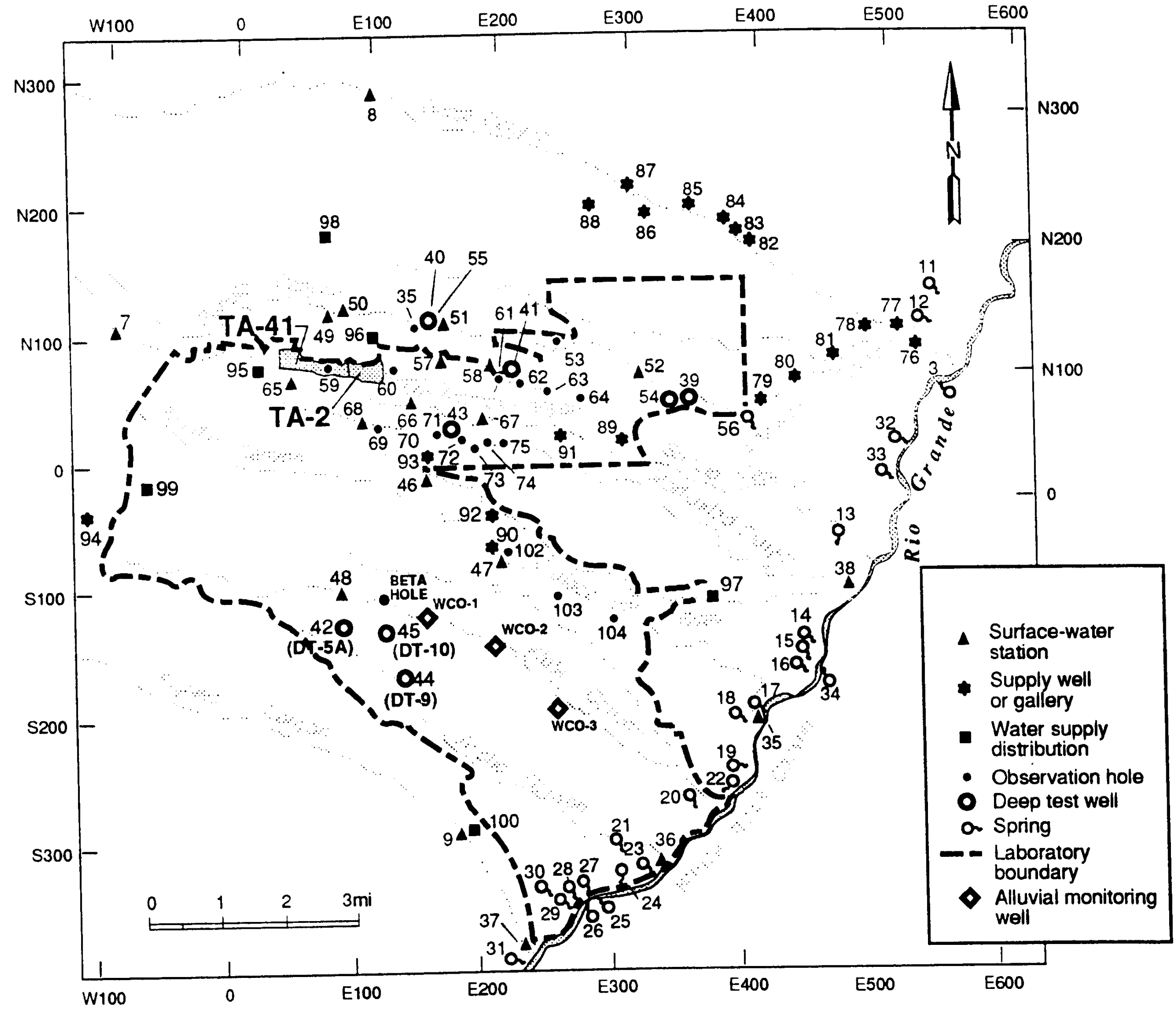


Figure 4.4-9 Surface water and groundwater sampling locations within and near the Laboratory (ESG 1990,0497).

of water to the subsurface caused by these faults These investigations are discussed in more detail in Chapter 6.

Groundwater measurements taken in deep monitor wells located on the Pajarito Plateau indicate that the elevation of the potentiometric surface of the main aquifer rises westward from the Rio Grande through the Tesuque Formation and the lower part of the volcanics and sediments beneath the central and western part of the Pajarito Plateau (Figure 4.4-8). Groundwater has been postulated to move eastward toward the Rio Grande, where it partially discharges into the Rio Grande through seeps and springs (LANL 1992, 0768; Purtymun et al. 1980, 0208). Recharge to the main aquifer may occur within Los Alamos Canyon where the Otowi Member, Puye Formation, basalt, and other coarse-grain materials are present. Other possible zones of recharge include the Pajarito Fault Zone, canyons, and possibly the eastern side of Sierra de los Valles within the Jemez Mountains.

The hydraulic gradient of the main aquifer in the vicinity of OU 1098 is approximately 120 ft/mile, based on the generalized water level contour map (Figure 4.4-8). Movement of groundwater is perpendicular to the potentiometric surface in unfractured rock.

The average groundwater flow velocity in the main aquifer in the vicinity of the Los Alamos Canyon (calculated on average thickness and coefficient of permeability values) is approximately 40 to 60 ft/year (Purtymun and Stoker 1988, 0205).

Water from well TW-3, located at the confluence of Los Alamos and DP canyons, is a sodium bicarbonate type (ESG 1990, 0497). Average TDS concentration, from 1984–1988, for groundwater samples is 129 ± 49 mg/L. Radiochemical analyses of the groundwater since 1986 indicate no detectable contamination of the main aquifer, excluding cesium-137, which had an activity one observation of 209 pCi/L near detection units (ESG 1990, 0497). The DOE calculated guides for cesium-137 for drinking water systems is 120 pCi/L (see Table 4.4.1). Activities of cesium-137 reported by ESG from previous years are less than 100 pCi/L, which may suggest that the 1990 value of 209 pCi/L is a statistical variant. TW-3 is currently being resampled for cesium-137 and other solutes.

4.4.4 Hydrogeological Properties of Tuff

Hydrogeological properties of Bandelier Tuff, such as porosity, permeability, moisture content, hydraulic conductivity, and moisture characteristic curves, are required for modeling of contaminant movement for risk assessment calculations. Geochemical data, including multiparameter adsorption properties, particle-surface area, vadose-zone chemistry, and mineralogical characterization, are also required for risk assessment and geochemical and solute transport modeling. Most of the available data are for crushed tuff; little data on *in situ* properties are available. In addition, the influence of fractures, and secondary minerals that line the fractures, is not known. The following discussion summarizes the limited existing information on such properties of the Otowi Member of the Bandelier Tuff, the unit immediately underlying the alluvium at TA-2 and TA-41. The discussion is based on hydrological laboratory measurements of intact core samples of the Otowi Member obtained from two boreholes in Mortandad Canyon (Stoker et al. 1991, 0715) and from one borehole in Sandia Canyon (D.B. Stephens and Associates 1991, 14-0044).

4.4.4.1 Porosity

The various units of the Bandelier Tuff tend to have relatively high porosities. Porosity ranges from 43% to 63% by volume. Porosity ranges from 30% to 60% by volume on other tuff samples collected within the Laboratory, generally decreasing for more densely welded tuff [see Subsection 2.6.2 of the IWP (LANL 1992, 0768)]. The effective porosity ranges from 18% to 52%, indicating interconnected or fluid-accessible porosity (D. B. Stephens and Associates 1991; Stoker et al. 1991, 0715).

4.4.4.2 Moisture Content

Moisture content of the Otowi Member of Bandelier Tuff in three boreholes (one borehole in Sandia Canyon and two boreholes in Mortandad Canyon; see Figure 4.4-2) has been measured to assess movement of water through the unsaturated zone. The moisture content of the Otowi in these boreholes is moderate, generally ranging from 20 to 40% by volume (D. B. Stephens and Associates 1991; Stoker et al. 1991, 0715). These values are considerably higher than those typically reported for the mesa tops [Weir and Purtymun 1962, 0228; Subsection 2.6.2 of the IWP (LANL 1992, 0768)]. Results of this investigation suggest that greater infiltration of water occurs in the canyon bottoms than through the mesa tops.

4.4.4.3 Hydraulic Conductivity

Hydraulic conductivity is a measure of the amount of fluid flow within solid material. Saturated cores of the Otowi Member of Bandelier Tuff have hydraulic conductivities in the range 0.03 to 28 cm/h. The hydraulic conductivity of unsaturated Bandelier Tuff varies with moisture content and has values two to five orders of magnitude lower than that for saturated tuff (2×10^{-4} to 2×10^{-7} cm/h for welded tuff, and 0.011 to 1.2×10^{-5} cm/h for nonwelded tuff) (Stoker et al. 1991, 0715).

4.4.4.4 Moisture Characteristic Curve

One of the key relationships describing the movement of water in unsaturated porous media is the water characteristic curve that relates water content of the solid phase to suction, tension, or negative pressure head. The characteristic moisture curve also is used to determine the relative hydraulic conductivity so that flux values can be calculated for water contents below saturation.

There have been numerous moisture characteristic determinations done on crushed Bandelier Tuff, although only limited *in situ* moisture characteristic data are available, particularly for the low water content generally found in the Bandelier Tuff (Abeele 1984, 0002).

4.5 Geology

Section 2.6 of the IWP and this chapter discuss the regional setting and general geology of the Pajarito Plateau. The following brief discussion pertains to the geology in the immediate vicinity of TA-2 and TA-41.

4.5.1 Bedrock Stratigraphy

TA-2 and TA-41 lie on the east flank of the Jemez Mountains volcanic field and on the active west margin of the Española Basin of the Rio Grande Rift (Figure 4.5-1). Factors that may affect the actual geometry and distribution of subsurface units beneath TA-2 and TA-41 include abrupt lateral and vertical facies variations in rock units, significant relief on paleotopographic surfaces on which rock units were deposited, and fault offsets in the older units that are masked by the younger rocks, which themselves show little or no displacement.

The rocks exposed in the area of TA-2 and TA-41 are the Cerro Toledo Rhyolite (1.1 to 1.5 myr), Tshirege Member (1.1 myr), and Otowi Member (1.5 myr) of the Bandelier Tuff (Spell et al. 1990, 0607). The Tshirege and Otowi Members and Cerro Toledo Rhyolite outcrop as cliff faces along the northern and southern sides of Los Alamos Canyon. The Otowi Member forms gentle slopes near the base of canyon walls or is overlain by alluvium. All the PRSs present at TA-2 and TA-41 are located on soil and alluvium which overlie the Otowi Member. One relatively detailed geologic map of the Bandelier Tuff exists for the TA-2 and TA-41 vicinity (Vaniman and Wohletz 1990, 0541) (Figure 4.5-2). These investigators divide the Tshirege Member into units based mainly on physical characteristics imparted by the cooling history of ignimbrite flow units. Tuffaceous sediments and tuffs of the Cerro Toledo Rhyolite and interbedded sediments were deposited between the Tshirege and Otowi Members of the Bandelier Tuff throughout the Pajarito Plateau. The Tsankawi Pumice occurs at the base of the Tshirege and is distributed widely along the eastern boundary of the Laboratory. The sediments include intercalated lenses of coarse boulder conglomerates and undulating channel fills that may provide permeable horizontal pathways for fluid migration. Fluvial sedimentary rocks of the Puye Formation and Santa Fe Group form the major hydrogeologic units beneath the Bandelier Tuff. Porous and permeable horizons, such as the Totavi Lentil, are interbedded with these sedimentary units and are potential transport pathways.

The stratigraphy in the area of TA-21, 1 mile east of TA-2, is given in Figure 4.5-3 including anticipated depths of stratigraphic contacts and thicknesses of rock units. No boreholes at TA-2 and TA-41 have penetrated to depths greater than 50 ft and, therefore, the stratigraphic characteristics of the Otowi Member are determined from outcrops. The stratigraphy of the upper rock units at TA-2 and TA-41 can be observed directly in excellent exposures of outcrops on canyon walls and slopes surrounding the site. Stratigraphic

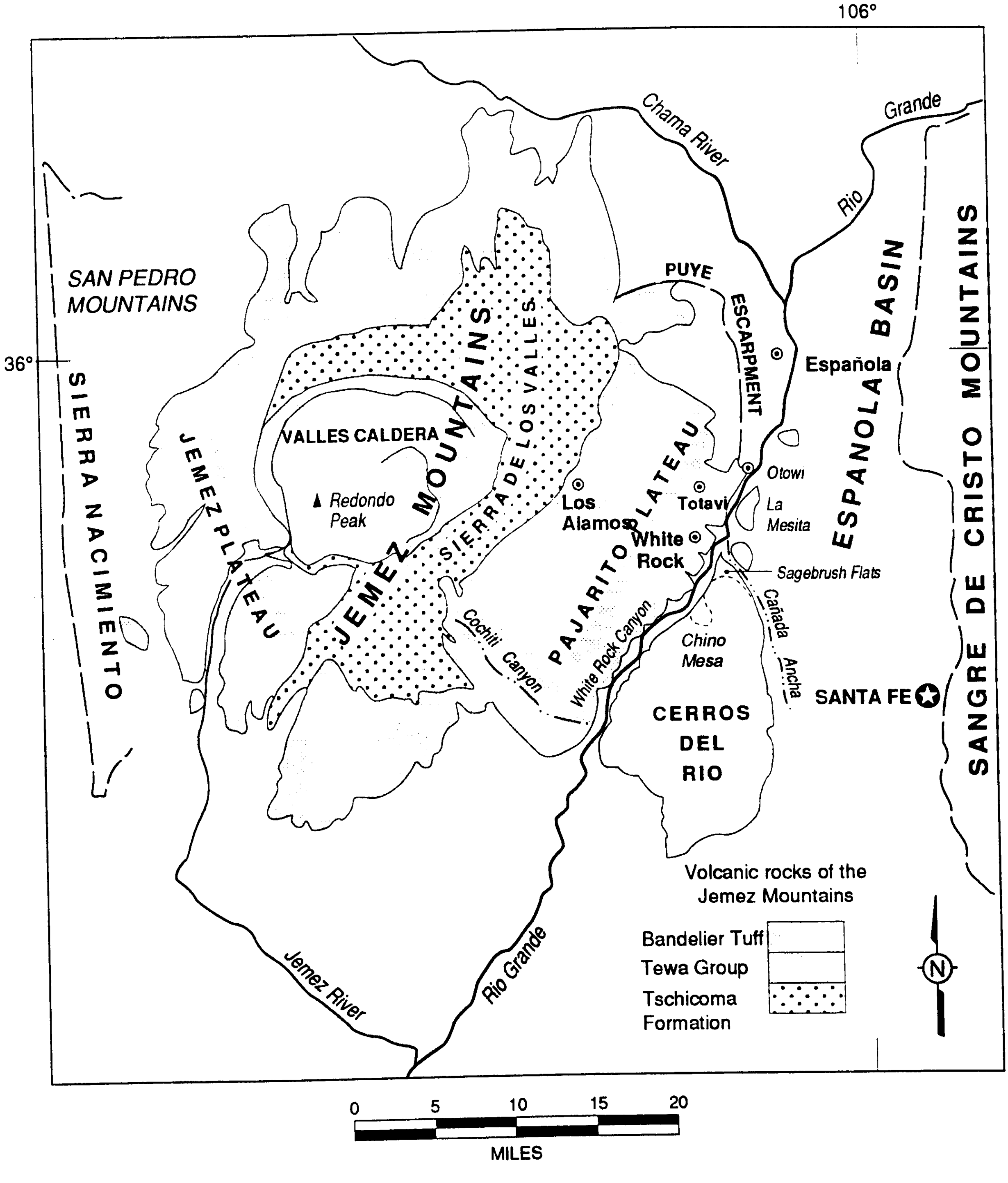


Figure 4.5-1 General geographic location and topographic features in the vicinity of Los Alamos.

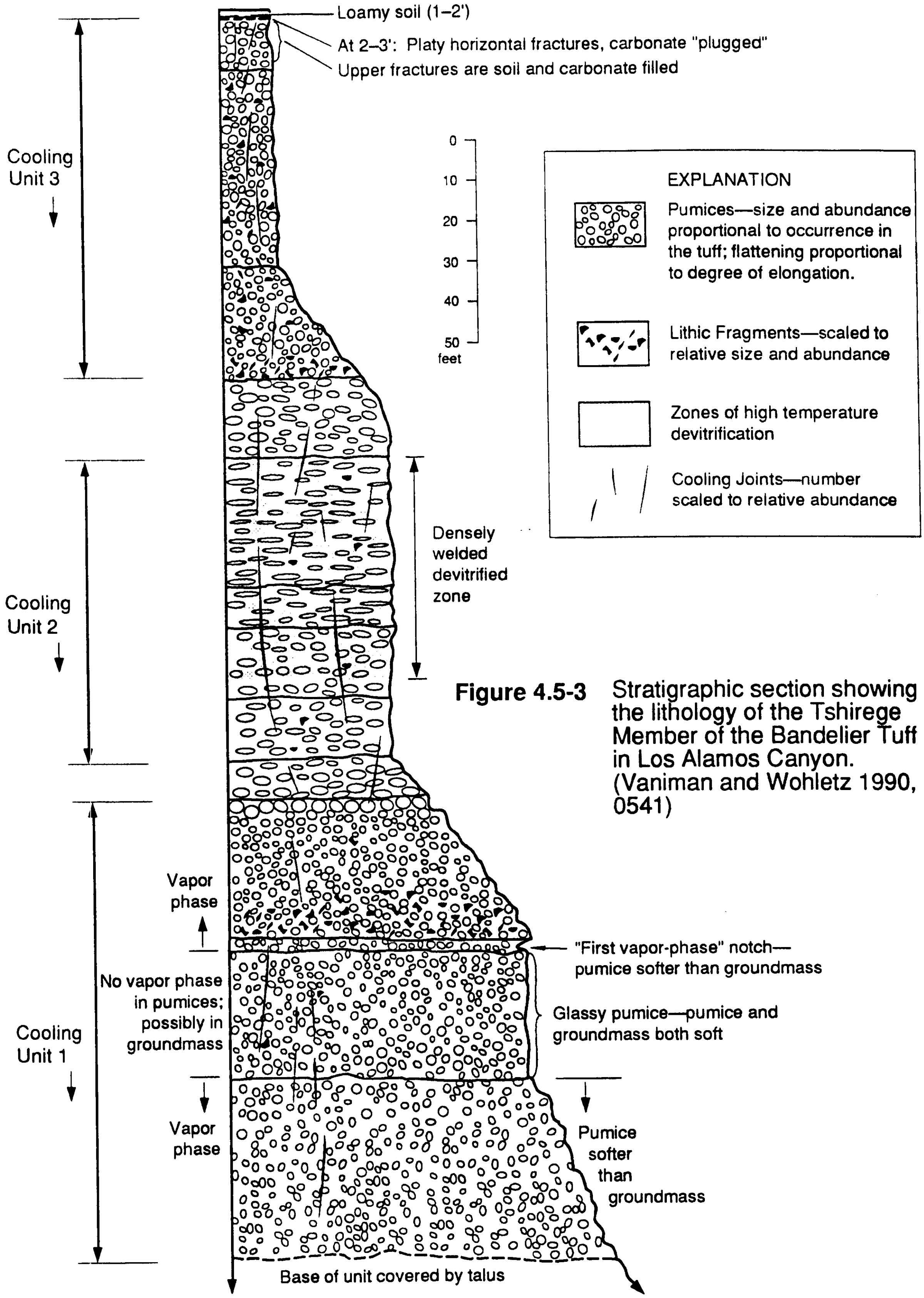


Figure 4.5-3 Stratigraphic section showing the lithology of the Tshirege Member of the Bandelier Tuff in Los Alamos Canyon. (Vaniman and Wohletz 1990, 0541)

information obtained from the Otowi-4, Otowi-1, and EGH-LA-1 wells (Figure 4.4-6) were also included in Table 4.5-1.

Inconsistencies exist in stratigraphic subdivisions of the Bandelier Tuff among various reports (Weir and Purtymun 1962, 0228; Baltz et al. 1963, 0024; Crowe et al. 1978, 0041; Vaniman and Wohletz 1990, 0541). Many of the stratigraphic discrepancies are caused by variations in nomenclature for different units.

Geologic uncertainties about the thicknesses, ages, and identities of deep stratigraphic units beneath TA-2 and TA-41 may need to be resolved and correlated with other stratigraphic units beneath the Laboratory.

4.5.2 Geological Structure

The Pajarito fault system forms the western margin of the Española Basin and has had Holocene movement and historic seismicity (Gardner and House 1987, 0110; Gardner et al. 1990, 0639).

In addition to the main trace of the Pajarito fault, other faults are exposed at the surface of the Bandelier Tuff in Los Alamos County. The Rendija Canyon fault, a normal-oblique slip fault with north-south orientation crosses TA-41. The Guaje Mountain fault has been mapped as far south as TA-55 about 1 mile south of TA-2 and TA-41 (Figure 4.5-2). This fault passes directly beneath TA-2. The Rendija Canyon and Guaje Mountain faults are exposed north of Los Alamos Canyon, as zones of gouge and breccia up to several meters wide with visible offset of stratigraphic horizons. Detailed fracture analysis of these faults may help identify and locate tectonic fracture zones within OU 1098.

Dransfield and Gardner (1985, 0082) integrated a variety of data to produce structure contour and paleogeologic maps of the pre-Bandelier Tuff surface beneath the Pajarito Plateau (Figure 4.5-3). Their maps reveal that subsurface rock units are cut by a series of down-to-the-west normal faults. The overlying Bandelier Tuff is not obviously displaced by these buried faults south of Los Alamos Canyon, showing that most displacements predated tuff deposition at least in the uppermost ashflow units. Displacement on the Guaje Mountain and Rendija Canyon faults decreases south of Los Alamos Canyon and discrete faults are replaced by wide zones of intense brecciation and fracturing superimposed on the network of cooling joints in the Bandelier Tuff (Vaniman and Wohletz 1990, 0541) (Figure 4.5-4).

4.5.3 Seismicity and Volcanism

Technical Area-2 and TA-41 lie within a region dominated by Late Pleistocene volcanic and recent tectonic activity. Volcanism began in the Jemez Mountains volcanic field more than 13 million yr ago and continued without a significant hiatus up through about 130 thousand yr ago (Gardner et al. 1986, 0310).

Given the long history of spatially focused, continuous volcanic activity, future volcanism may be expected in the region. Examination of the area's tectonic history indicates that future volcanism would likely be tens of kilometers north of

TABLE 4.5-1

ESTIMATES OF STRATIGRAPHIC THICKNESSES FOR MAJOR ROCK UNITS AT TA-21, LOS ALAMOS, NEW MEXICO

Thickness ft	Thickness m	Description
260–325	79–99	Tshirege Member Bandelier Tuff: crystal-rich non- to moderately welded rhyolitic tuff; phenocrysts of sanidine and quartz; 2% lithic fragments; at least four flow units; thin (~0.5 m) Tsankawi Pumice Bed exposed at base.
0–30	0–10	Cerro Toledo Rhyolite: discontinuous unit of three to five air-fall tuffs interbedded with epiclastic sands and gravels; tuffs are nearly aphyric; epiclastic sands and gravels; tuffs are nearly aphyric; epiclastic units dominated by dacite clasts from Tschicoma Formation.
290–310	88–94	Otowi Member, of Bandelier Tuff: crystal-rich rhyolitic tuff; similar to Tshirege Member but generally non-welded and vitric throughout; more lithics; Guaje Pumice Bed may be 10-m thick; base of unit not exposed (Weir and Purtymun 1962, 0228; Griggs and Hem 1964, 0313; Purtymun and Stoker 1987, 0204).
940	287	Puye Formation: Gray conglomerate consisting of boulders, cobbles, and gravels in a sandy matrix; dominated by dacitic clasts from Tschicoma Formation, may contain interbedded basalt flows of Cerros del Rio and dacitic to andesitic flow of Tschicoma Formation.
unknown		Santa Fe Group: tan to pink sandstone and siltstone generally containing fragments of granitic rocks and quartzite from Precambrian sources toward the north; may contain interbedded flows of Cerros del Rio basalts and Tschicoma Formation dacite; may be interbedded with Puye Formation.

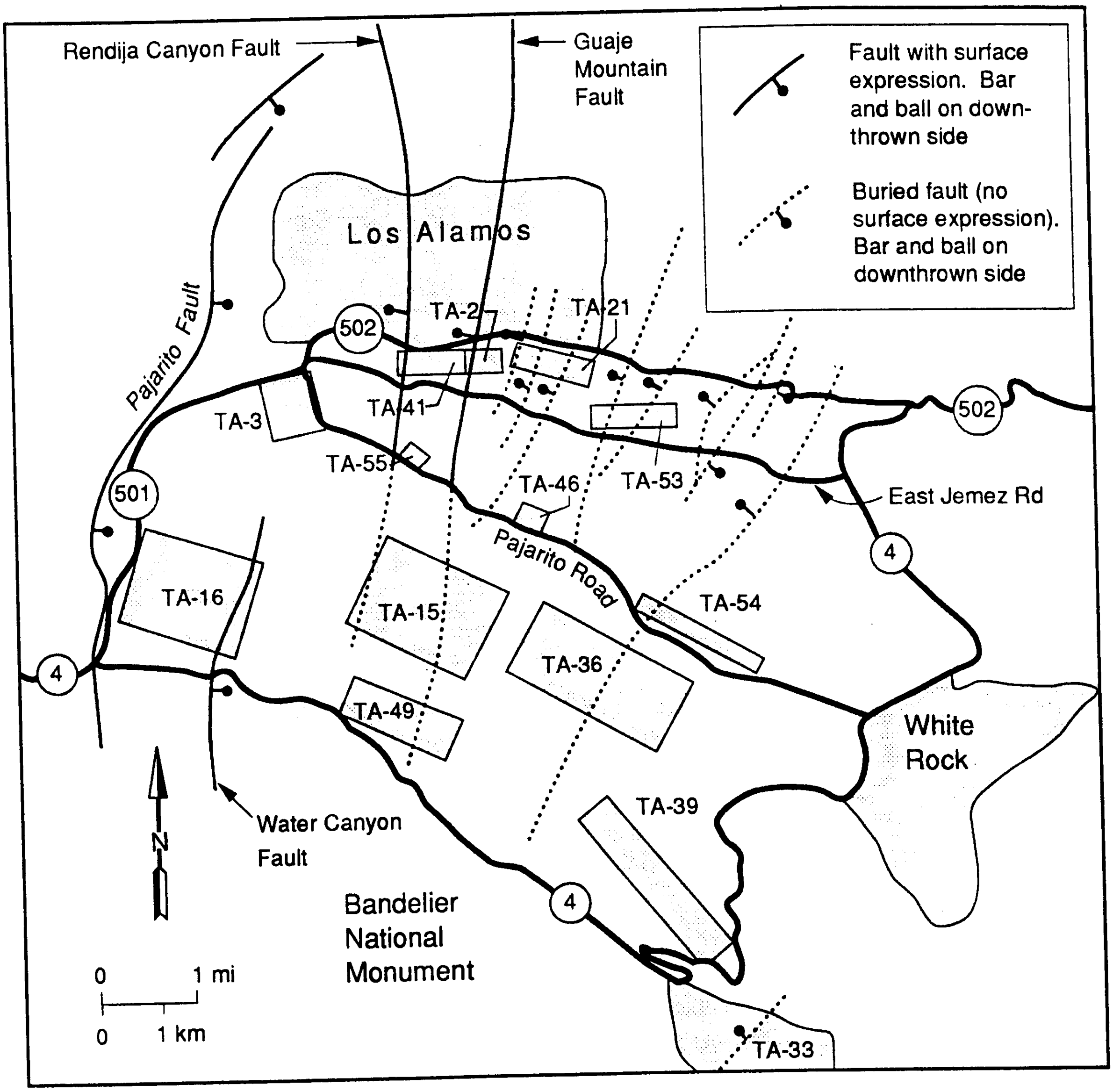


Figure 4.5-4 Locations of major faults at selected Laboratory technical areas, Los Alamos, White Rock, and major roads (modified from Dransfield and Gardner 1985, 0082) and Gardner and House (1987, 0110).

TA-2 and TA-41 (Gardner and Goff, 1984, 0719; Gardner 1985, 0721; Self et al. 1986, 0375).

4.6 Biological Setting of OU 1098

An initial biological survey of OU 1098 was carried out to be used in conjunction with this RCRA Facility Investigation (RFI) as part of National Environmental Policy Act (NEPA) requirements. A final report will be prepared, which will address statory requirements for the survey, and the nature methods, location, and results of the survey. The survey documents the biological setting and assesses the potential impact of the RFI on biological resources (Appendix I of this work plan).

The portion of Los Alamos Canyon within OU 1098 is located in a ponderosa pine forest with a varied shrub layer. Common shrub species include Gambel's oak, wavyleaf oak, skunkbush sumac, mountain mahogany, willow, and New Mexico olive. Important understory species include blue grass, blue grama grass, mountain muhly, and sedges. On north-facing slopes at higher elevations, Douglas-fir occurs as a dominant. Operable Unit 1098 contains the following habitat types:

- Ponderosa pine/Wavyleaf oak, mountain muhly phase;
- Ponderosa pine/Willow, carex phase;
- Douglas-fir/Gambel's oak, mountain muhly phase;
- Ponderosa pine/Gambel's oak, poa phase; and
- Ponderosa pine/New Mexico olive blue grama phase.

In addition to the above habitat types, riparian areas and wetlands occur along the stream channel within Los Alamos Canyon. These have been broadly mapped by the U.S. Fish and Wildlife Service.

The OU contains an estimated 133 species of plants, 71 species of birds, 32 species of mammals, and 9 species of reptiles and amphibians. The varied shrub canopy and understory of both ponderosa pine and mixed conifer forests support a large number of nesting birds including raptors.

No threatened, endangered, or sensitive species were found during the field season of 1992.

Jemez Mountains salamanders were not discovered in the survey conducted in the summer of 1991 on the north-facing slope in Los Alamos Canyon. However, in the past years, specimens have been found in the general area.

Spotted bats are not known to occur in Los Alamos Canyon, but all habitat components necessary to support them are present.

Northern goshawks have not been found in raptor surveys conducted in Los Alamos Canyon. However, some of their habitat components exist within this area.

Meadow jumping mice have not been found in OU 1098. However, their presence remains a possibility.

Peregrine falcons may use lower Los Alamos Canyon as an alternate nesting area.

Cooper's hawks are known to nest in Los Alamos Canyon and this nest has been very productive throughout the years. This species does not have a threatened or endangered species status, but it is protected from harassment and collection.

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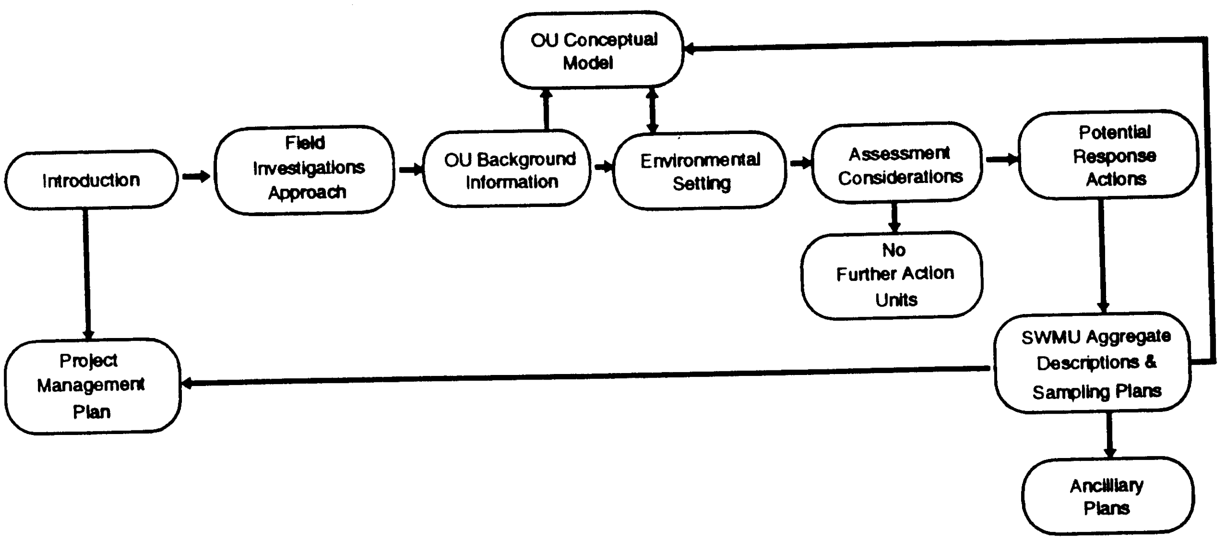
Chapter 5



Geochemistry , Contaminant Migration, and Conceptual Model

- Geochemistry
- Environmental Monitoring
- Pathways
- Potential Receptors
- Public Health and Environment
- Los Alamos Canyon
- General Data Needs

CHAPTER 5.0 GEOCHEMISTRY, CONTAMINANT MIGRATION, AND CONCEPTUAL MODEL

Chapter 5 presents a detailed description of geochemistry, public health and environmental impacts, and conceptual model of operable unit (OU) 1098 [Technical Area-2 (TA-2) and TA-41] on which the Potential Release Site (PRS)-specific RCRA Facility Investigation (RFI) plans in Chapter 7 and the recommendations for no further action (NFA) (Chapter 8) are based.

Chapter 5 presents and interprets existing information relevant to TA-2 and TA-41.

- 5.1 Geochemistry
- 5.2 Routine Environmental Monitoring at TA-2 and TA-41
- 5.3 Potential Pathways of Contaminant Migration
- 5.4 Potential Receptors
- 5.5 Public Health and Environmental Impacts
- 5.6 TA-2 and TA-41 Site and Los Alamos Canyon Site Conceptual Model
- 5.7 Summary of General Data Needs

Sections 5.1 through 5.5 provide a general foundation culminating in a conceptual model described in Section 5.6. This model identifies the potential for contaminant migration at TA-2 and TA-41 and the environmental pathways and receptors (pertinent to Phase I investigation) which are discussed further in this chapter. These investigations will be conducted in two phases and will be coordinated with other OUs (TA-1, TA-21, TA-43, and TA-53) adjacent to the Canyon, the Frameworks team, and the Canyons OU team.

The development of general data needs and the site-conceptual model in Chapter 5 are used to evaluate the nature, quantity, and quality of data required to support the purposes of this RFI as summarized in subsequent chapters. These chapters address the ultimate objective of selecting remedial alternatives based on human health, environmental impact, implementability, and cost considerations.

The general data requirements and conceptual model identified in Chapter 5 are used to develop the PRS-specific field sampling plans presented in Chapter 7. As field results become available, an iterative process will begin in which current knowledge will be updated; the sufficiency of the data for supporting the RFI objectives will be assessed; additional data needs will be identified; and further investigations will be designed to fulfill those needs.

5.1 Geochemistry

Principal contaminants of geochemical concern in PRSs at TA-2 and TA-41 are beryllium, cesium, chromium, mercury, uranium, plutonium, tritium, and fission products. Tritium, chromate, and uranyl [U(VI)] are mobile under oxidizing and alkaline conditions. The other contaminants listed above are expected to sorb to a varying degree to site soils and sediments and will transport with them in surface water environments. Dissolved species of strontium, cesium, and other fission products, however, occur in alluvial groundwater within Los Alamos Canyon (ESG 1990, 0497). Cation exchange and specific adsorption (with oxides of iron and manganese) will contribute to partial attenuation of contaminants within the sediments of the alluvial aquifer and in the overbank deposits. Uranium is expected to be in the (VI) valence state in the alluvial aquifer in the absence of chemical reductants such as hydrogen sulfide. However, in the soils it could be present in either the tetravalent state or the more soluble hexavalent state. Strontium is expected to be present in the divalent state and to have relatively greater solubility than the actinides, excluding uranyl.

Substantial data are available related to radionuclide transport in volcanic tuff from investigations of the proposed Yucca Mountain (YM) high-level waste repository (Thomas 1987, 0697), but data are relatively limited for the Bandelier Tuff. The chemical compositions of the volcanic tuff at YM and the Bandelier Tuff are probably similar based on eruptive history and similar mineralogy. Therefore, the adsorption data for YM are applicable for a general discussion with the Bandelier Tuff. The YM data can be used to provide crude estimates of TA-2 and TA-41 retardation factors for the Bandelier Tuff, even though YM Tuff is much more highly welded (greater density) than that of the Pajarito Plateau and calculated retardation factors (R_f) would be larger with increasing rock density (see Table 5.1-1). Site-specific adsorption data, however, are required for soils, alluvium, and tuff at TA-2 and TA-41 to establish a high degree of confidence and quantification of geochemical processes used as input parameters for risk assessment modeling. General literature also is available on retardation factors for radionuclides, with porous materials. Examples of available retardation data for Yucca Mountain Tuff are given in Table 5.1-1.

Geochemical studies of tuff, soils, and sediments of the Pajarito Plateau are summarized in Chapter 2 of the IWP (LANL 1992, 0768). No values of retardation factors are available for tritium, beryllium, chromium, and mercury (potential key TA-2 and TA-41 contaminants) and only a few measurements have been made for radionuclides for any adsorptive media from the Laboratory. No retardation data are available for sorptive media present at TA-2 and TA-41. The only cation exchange data for the Bandelier Tuff is reported to range from 0.5 to 4.0 meq/100 g (Purtymun and Stoker 1987, 0204), which are small as compared with clay minerals (3-150 meq/100 g) (Birkeland 1984, 0239).

The following discussion describes geochemical and contaminant-transport characteristics of chromium, mercury, cesium, tritium, and uranium. This discussion is focused on the mobilities of these contaminants in aqueous solutions. This discussion is useful in developing sampling plans (Chapter 7) for determining the area of extent that would be required for accurately

TABLE 5.1-1

TYPICAL ADSORPTION RATIOS FOR YUCCA MOUNTAIN TUFF (ADAPTED FROM THOMAS 1987, 0697)

ELEMENT	SORPTION RATIO, R_d
Chromium	not known
Cesium	200–1200
Neptunium	5
Plutonium	300–1600
Strontium	20–80
Tritium	0
Uranium	5

The adsorption ratio, R_d, is used as a measure of adsorption as a function of many parameters. It is defined as

$$R_d = \frac{\text{activity in solid phase per unit mass of solid}}{\text{activity in solution per unit volume of solution}}$$

and is expressed in units of milliliters per gram(ml/g). This ratio is often referred to as the distribution coefficient, K_d. The Laboratory prefers not to use this term, which implies equilibrium, because reversible equilibrium is usually not attained. If equilibrium is attained, then K_d is related to a retardation factor, R_f, in a uniform flowing system by

$$R_f = K_d\,(p/e) + 1,$$

where p is the bulk density and e is the porosity of the rock. Oxidizing conditions are assumed.

characterizing contaminant mobility during Phase I and Phase II activities. Contaminant mobility is, in part, controlled by geochemical properties (solubility, adsorption, desorption, etc.) of each species. Cesium, chromium, mercury, and tritium occur as cationic species between pH 5 to 8. Chromium and uranium can occur as anionic species under the same pH and oxidizing conditions.

Large amounts of potassium dichromate ($K_2Cr_2O_7$) were used as a fungicide in the cooling-tower blowdown and subsequently were released to the environment as drift loss (SWMU no. 2-005). Chromium is a contaminant of concern at TA-2 because of its potential widespread dispersion within the soils and sediments within Los Alamos Creek, which passes within 50 ft of the cooling tower.

Chromium exists as Cr(III) and its hydrolysis products under reducing and moderately oxidizing conditions, whereas under strongly oxidizing conditions it exists as Cr(VI) (Rai and Zachara 1988, 0879). Chromium(III) and Cr(VI) exhibit marked differences in their geochemical behavior. Chromium(III) is strongly adsorbed by minerals and solid phases present in soils and sediments through specific adsorption and ion exchange. Chromium(III) exists as cations Cr^{3+}, $CrOH^{2+}$, $Cr(OH)^{2+}$, $Cr_2(OH)_4{}^{2+}$, and $Cr_6(OH)_{12}{}^{6+}$ over a wide range of pH values. Chromium(III) adsorption increases with increasing pH. These results suggest that if Cr(III) is the stable redox state of chromium, then this contaminant should be fixed within soil horizons and should have limited leachability at TA-2. Leaching tests and redox-speciation studies of Cr(III) and Cr(VI) are required to evaluate the mobility of chromium at TA-2, if Cr concentrations approach screening action level (SAL) for Cr (VI) which is 400 ppm.

Conversely, Cr(VI) exists as anions ($HCrO_4{}^-$ and $CrO_4{}^{2-}$) and is specifically adsorbed by ferric oxyhydroxides below pH 7 (Rai and Zachara 1988, 0879). Thus, chromate shows significant mobility under neutral and basic pH conditions. Chromium(VI) undergoes reduction to Cr(III) by soluble organic ligands and particulate organic matter, humic acid, and fulvic acid (Rai and Zachara 1984, 0880; Rai and Zachara 1988, 0879). Organic ligands including ascorbic and citric acids form stable Cr(III) complexes and have been shown to decrease Cr(III) adsorption by 80% to 90% onto amorphous $Fe(OH)_3$ in seawater at pH 8. These organic acids may have been discharged from an outfall (SWMU no. 2-008) from the photography laboratory at TA-2.

Various minerals and solid phases have been reported to control the solubility of chromium under oxidizing and reducing conditions (Rai and Zachara 1984, 0880). These include Cr_2O_3, $FeCrO_4$, $BaCrO_4$, $PbCrO_4$, and $Cr(OH)_3$. Of these minerals, $Cr(OH)_3$ and Cr_2O_3 are considered to be the most important based on soil-mineral characterization studies summarized in EPRI (Rai and Zachara 1988, 0879; Rai and Zachara 1984, 0880). Specific minerals containing Cr(III) and Cr(VI) have not been identified within soils at TA-2; however, selective leaching tests on soils and sediments are proposed to evaluate the leachability of chromium.

During operation and decommissioning of the Clementine Reactor, unknown quantities of mercury may have been released to soils and sediments. There are no monitoring data available at TA-2 to evaluate potential mercury contamination.

Mercury can exist in different oxidation states (0, 1^+, 2^+), depending on the redox potential. Under oxidizing conditions, mercury compounds exhibit high solubility and, therefore, mercury-controlling solids have not been reported (Lindsay 1979, 0883). Under oxidizing conditions where many Hg(II) compounds are soluble, the primary attenuation mechanism of mercury is expected to be adsorption and desorption processes (Rai and Zachara 1984, 0880). Particulate organic carbon and hydrous oxides of iron and manganese have been shown to be the most important adsorbents under low concentrations of mercury (Rai and Zachara 1984, 0880). Under existing site conditions with humic and fulvic acids present in the soils, mercury uptake could be significant. Adsorption of Hg(I,II) onto silica surfaces is high between a pH range of 5 and 8 in the absence of complexing ligands such as chloride (Rai and Zachara 1984, 0880). Selective leaching tests on soils and sediments are proposed to evaluate the leachability of mercury.

Contamination of soil and groundwater by cesium-137 at TA-2 has been documented by Elder and Knoell (1986, 14-0014). In aqueous solution, cesium occurs as Cs^+ and there is little, if any, tendency for it to form complexes in natural environments (Brookins 1984, 0881). Cesium undergoes cation-exchange reactions with clay minerals and soils, and the amount of exchange is affected by competition from hydrogen, strontium, sodium, and other cations. Distribution coefficients for cesium typically range from 0 ml/g for quartz to 4900 ml/g for smectites (expandable clay mineral) (Ames and Rai 1978, 0878). Mineral surface area is the dominant factor controlling the extent of cesium adsorption. Cesium adsorption within localized clay-rich soil horizons at TA-2 may be significant, whereas decreasing sorption probably occurs in the coarse-grained sediments and alluvium. Elevated activities of cesium-137 have been observed in alluvial groundwater within Los Alamos Canyon (ESG 1990, 0497). Surface sediments collected by EM-8 show that cesium-137 has migrated along Los Alamos Creek and that activities of cesium-137 are elevated above background up to a factor of 19 east of TA-2 (see Figure 4.3-5). Additional sources of cesium-137 originate at TA-21, and contaminated sediments are being transported down DP Canyon and also from TA-21 outfalls discharging to Los Alamos Canyon.

Elevated above background activities of tritium occur in alluvial groundwater within Los Alamos Canyon (ESG 1990, 0497). These elevated tritium activities are attributed to past and/or present conditions mainly at TA-2, where tritium is an activation product in the cooling water. Tritium behavior in soils is similar to that of hydrogen and exists as an ion, gas, and liquid. Tritiated water is expected to be the dominant tritium species found in soils at TA-2 and TA-41. It may undergo exchange reactions with protons associated with carboxylic acid and phenolic functional groups in humic and fulvic acids present in soils. Tritium is expected to migrate at the same rate as the average groundwater flow velocity, and vapor-phase transport of tritium through soils may occur. Distribution coefficients for tritium are expected to be very low or zero at TA-2 and TA-41 because of coarse-grained sediments with little cation exchange capacity.

Uranyl nitrate [$UO_2(NO_3)_2$] and uranyl sulfate [$UO_2SO_4^0$, $UO_2(SO_4)_2^{2-}$] solutions were used in previous reactors at TA-2. Under oxidizing and alkaline conditions, uranyl forms strong complexes with carbonate, including $UO_2CO_3^0$, $UO_2(CO_3)_2^{2-}$, and $UO_2(CO_3)_3^{4-}$, which can be mobile in the absence of adsorbing solid phases (Brookins 1988, 0882). Uranyl [U(VI)] minerals are moderately soluble in aqueous solution; under existing site conditions it is unlikely that these minerals have precipitated from solution unless significant concentrations of uranyl nitrate and or uranyl sulfate were spilled or discharged. Distributions of U(VI) within soil horizons at TA-2 and TA-41 are probably controlled by adsorption/desorption processes. In the presence of humic and fulvic acids, ferric oxyhydroxides, and clay minerals, uranyl sorption can be significant, and uptake of uranyl onto soils at TA-2 and TA-41 may account for the low concentrations of this species observed in groundwater at the site. Dissolved uranium concentrations in alluvial groundwater within Los Alamos Canyon are typically in the µg/L range (ESG 1990, 0497) (see Figure 4.4-4). This range suggests that contamination of the alluvial aquifer by uranium has not occurred. Selective leaching tests on soils and sediments are proposed to evaluate the leachability of uranium at TA-2 and TA-41.

Some mineralogical and chemical characterizations of soils, sediments, lower Bandelier Tuff, and fracture-filling materials may be needed for TA-2, TA-21, and TA-41 to add to our geochemical transport-related data. Data needs particularly include an estimation of retardation factors for the principal contaminants and sorptive media at TA-2, TA-21, and TA-41 for purposes of risk assessment evaluations.

5.2 Routine Environmental Monitoring at TA-2 and TA-41

The Laboratory's routine environmental surveillance program is described in annual reports published by the Environmental Surveillance Group (EM-8). Data specific to Laboratory and regional background characterization studies of surface water, groundwater, soil and sediment, air quality, and ambient penetrating radiation levels are provided in the ESG reports. Three categories of monitoring stations are being used to collect data.

1. Regional stations are used to establish regional background levels at some distance from Laboratory operations. The regional stations are located within the five counties surrounding Los Alamos County at distances up to 50 miles from the Laboratory.
2. Perimeter stations are located closer to the Laboratory's boundaries. These stations are not affected by routine Laboratory operations; however they are used to insure that any unexpected releases from Laboratory operations are evaluated to establish background levels closer to Laboratory operations.
3. On-site stations are in proximity to Laboratory facilities and monitor the effect of releases close to the source. Such on-site stations at or near TA-2 and TA-41 are described in the following subsections.

5.2.1 Shell Gasoline Station, Los Alamos Airport, and East Gate Meteorological Stations

Since 1987, the Shell Gasoline Station (Station 10), Los Alamos Airport (Station 8), and East Gate (Station 6) meteorological stations located north and northeast of TA-2 and TA-41 have provided data continuously on air quality and climate. See Figure 5.2-1 for the locations of these monitoring stations.

5.2.2 Radiation Monitoring

Background neutron flux is measured by detectors at the Shell Station and Los Alamos Airport. Levels of airborne radionuclides (tritium, uranium, plutonium, and americium) are measured at a permanent station located at TA-2 (Station 25, Figure 5.2-1). The TA-2 station annual mean of 11.4 ± 4.4 pCi/m^3 (0.0114 ± 0.0040 pCi/l) of tritium was one of the highest annual means measured at the Laboratory in 1989 (ESG 1990, 0497). This station is located within the Laboratory boundary near an area where tritium was released or was used in operations. This tritium concentration is <0.1% of the concentration guide lines for tritium in air, based on DOE's Derived Air Concentrations for Controlled Areas (limited public access to TA-2 and TA-41).

A series of thermoluminescent dosimetry (TLD) stations have measured penetrating radiation levels at TA-2 and TA-41 for many years. The annual Environmental Surveillance reports indicate that doses at TA-2 and TA-41 are indistinguishable from regional background levels.

5.2.3 Surface and Groundwater Monitoring

As discussed in Chapter 4 (Subsection 4.4.3.1), deep test well TW-3 and six shallow alluvial wells, LAO-C, LAO-1, LAO-2, LAO-3, LAO-4, and LAO-4.5, are sampled at least annually as part of the Laboratory's environmental surveillance program. Surface run-off is sampled during or shortly after storm events in DP Canyon at TA-21 at stations DPS-1 and DPS-4. Groundwater contamination due to activities at TA-2 and possibly TA-41 has been detected within the uppermost alluvial aquifer (ESG 1990, 0497). The primary contaminants found in Los Alamos Canyon include tritium, strontium-90, and cesium-137, where these three isotopes have exceeded proposed DOE derived concentration guides (DCGs) for public dose for water (see Table 4.4-1) and background values up to two orders of magnitude within the Laboratory boundary (Figures 4.4-3, 4.4-3A, 4.4-3B, and 4.4-3C; Table 4.4-1) (ESG 1990, 0497). Other possible contamination sources derived from the former site(s) of TA-1 located on DP Mesa may have impacted Los Alamos Canyon near OU 1098.

5.2.4 Soil and Sediment Monitoring

Two permanent sediment stations are sampled annually near TA-2 and TA-41 as part of the ongoing Laboratory Environmental Surveillance Program (see

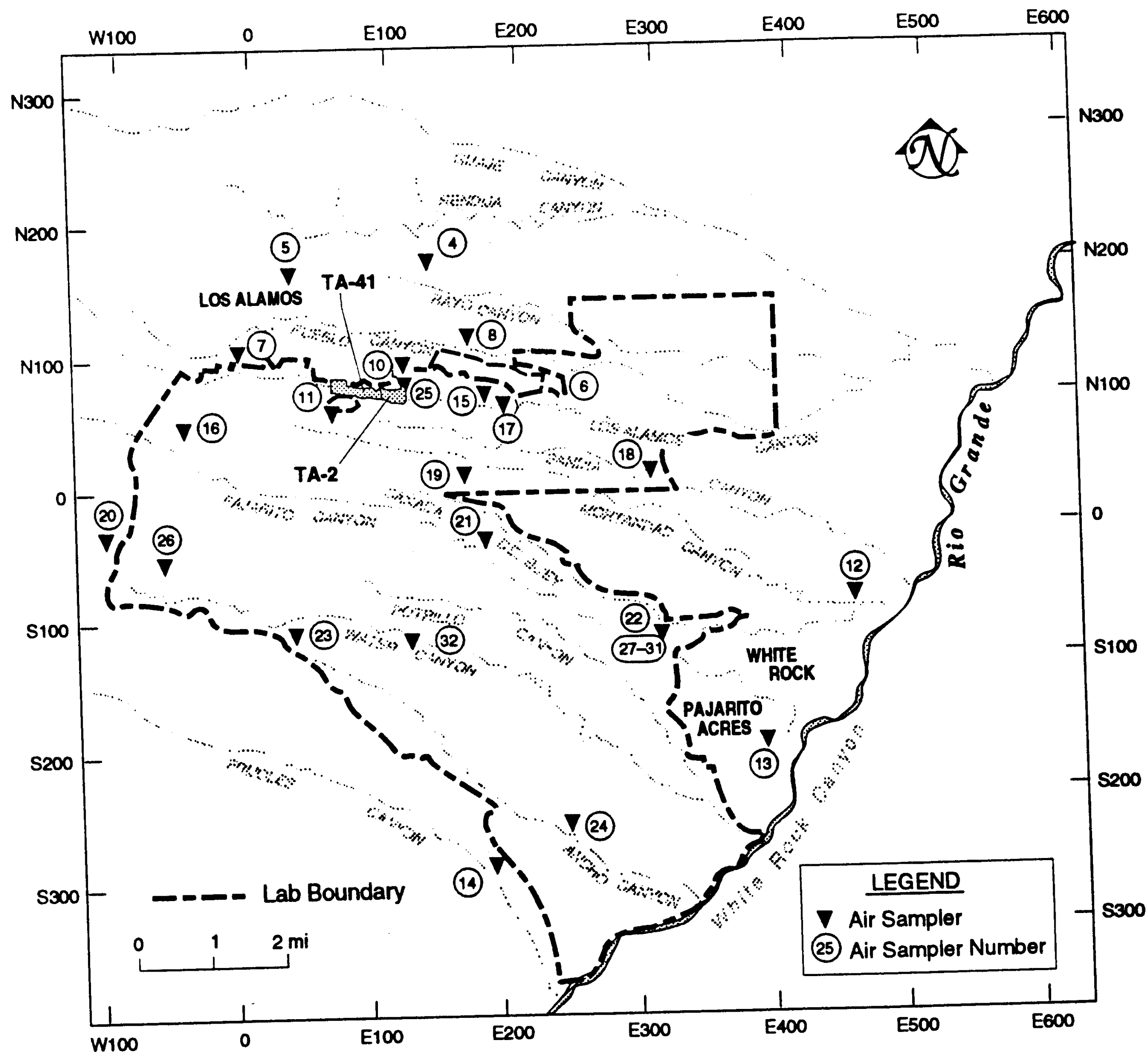


Figure 5.2-1 Locations on or near the Laboratory site for sampling airborne radionuclides (ESG 1990, 0497).

Chapter 4, Section 4.3.3). Additional annually sampled sediment stations are also present east of TA-2 and TA-41 within Los Alamos Canyon. Environmental measurements taken by ESG (1990, 0497) over two decades suggest that contaminants attributable to past or present TA-2 and TA-41 operations have been transported beyond the TA-2 and TA-41 boundaries to TA-21 within Los Alamos Canyon. Soil and sediment samples taken in locations east of the reactor building, where low-level near-surface radionuclide releases are known, have yielded individual soil samples with cesium-137 concentrations (Elder and Knoell 1986, 14-0014) of 1000 pCi/g above action levels (cesium-137; 4 pCi/g see Table 6.1-1). Radionuclide contamination, including plutonium-239/240 and plutonium-238 above background but well below screening action levels defined in Chapter 6, is found in Los Alamos Canyon. Activities of radionuclides in sediments generally increase to the east within Los Alamos Canyon toward TA-21.

As described in Chapter 7 of this work plan, the most significant wastes are associated with operation of different reactors formerly used at TA-2 and with the current Omega West Reactor (OWR). Surface water and groundwater data collected by EM-8 in early 1993 have shown that cooling water from OWR has seeped into the underlying soils and sediments. This leak was the primary source of tritium observed in 1993 in monitor wells located downgradient from OWR.

Decommissioning of the water boiler reactor and associated activities have removed most of the radioactive contaminants from soil and sediments above the water table (Elder and Knoell 1986, 14-0014). Clean soil was used as backfill in areas were soil excavation took place. Contaminated soil and sediments were taken to TA-50 and TA-54 for disposal. However, areas with elevated (1000 pCi/g) above background gross gamma readings remain east of the reactor building (TA-2-1).

5.2.5 Foodstuff Monitoring

There are no foodstuff monitoring stations within Los Alamos Canyon. Honey and bees from a hive located at TA-21 within DP Canyon east of OU 1098, however, were sampled in 1989 for radionuclides and a few heavy metals (ESG 1990, 0497). No levels significantly above regional background, excluding tritium in honey, were found. Activities of tritium were 31,000 ± 3,000 pCi/L at the TA-21 station (ESG 1990, 0497).

5.3 Potential Pathways of Contaminant Migration

The principal migration pathways at TA-2 and TA-41 PRSs over the assumed period of institutional control (100 yr) are surface erosion (water and air), surface-water transport, groundwater transport, human intrusion, ingestion, and potential uptake by biota in and around Los Alamos Creek, as will be discussed further in Section 5.6 and Chapter 6.

5.4 Potential Receptors

This section identifies receptors for contaminants that could be released from TA-2 and TA-41 PRSs with the hypotheses being based on pathways described in Subsection 5.4.3. Generic receptor scenarios for the Laboratory as a whole are being developed programmatically but are not yet available. The text to follow identifies representative receptors but is not intended to identify receptors for purposes of risk assessment.

5.4.1 Local Populations

Section 2.5 of the IWP (LANL 1992, 0768) describes the population distribution within a 50-mile radius of the Laboratory. Newer data from the 1990 census gives the total number of residents within the 50-mile radius of the Laboratory as 213 000. The closest residents to TA-2 and TA-41 are about 150 m to the north in Los Alamos. The 1990 census gives the population of Los Alamos as 11400. A moderately used road leads to the central portions of TA-2 and TA-41, but access to the TAs is restricted by fencing and signs. The point of closest public contact to PRSs at TA-2 and TA-41 is about 50 ft (outside of fenced areas).

The Laboratory currently has employees who spend normal working hours at TA-2 (17 employees) and TA-41 (99 employees). The site receives continuous use (8 hrs/day, 5 days/week) by a number of employees involved with reactor research and weapons research. Some activities are conducted in areas where potential contamination is expected. Laboratory service, environmental surveillance, and ER personnel as well as other incidental visitors are also on-site on an occasional basis.

5.4.2 Land Use

Land use in and around the Laboratory is described in Sections 2.5 and 4.3 of the IWP (LANL 1992, 0768). The likelihood is moderate that future land use in the vicinity of TA-2 and TA-41 will not change significantly within the 100-yr period assumed for institutional control. At present, site workers and downgradient receptors represent the potentially exposed population at OU 1098.

The possibility that the area encompassed by TA-2 might revert to the general public is unlikely under foreseeable circumstances. Portions of TA-41 and Los Alamos Canyon, however, could conceivably revert to reuse by the National Park Service (NPS) or the US Forest Service (Santa Fe National Forest). In this case, possible exposure to recreational users would need to be considered by risk assessment personnel before land transfer or alternative use occurs. Recreational use of TA-41 and Los Alamos Canyon, excluding TA-2, is considered to be a credible future land use scenarios for the purposes of this OU work plan (see Section 4.3.3 of the IWP).

5.4.3 Routes of Exposure and Pathway-Specific Receptors

For each contaminated TA-2 and TA-41 medium identified in this RFI work plan, exposure routes for potential receptors are identified as those pertinent to derivation of screening action levels (see Chapter 4 of the IWP). As new data are obtained and assessed in the TA-2 and TA-41 RFI, the focus on particular exposure scenarios will be reconsidered for purposes of performing a baseline risk assessment. Examples of those potential future exposure scenarios are presented below.

At present, the populations exposed to TA-2 and TA-41 contaminants are on-site workers and potential downgradient receptors, including wildlife, that may become exposed to contaminated groundwater discharging from springs, seeps, and gaining streams within Los Alamos Canyon. In the case of contaminated surface soils, inhalation, dermal contact, incidental ingestion, and external exposure to radioactive substances in soil are identified as the most likely exposure scenarios for wildlife inhabitants and humans that need to be considered. Plausible exposure scenarios involve dermal contact with contaminated surface water, ingestion of surface water, and external exposure to radioactive substances, assuming that the land is used for recreational purposes at some future time. Although the groundwater in Los Alamos Creek is shallow (e.g., less than one ft deep), it is possible that ingestion would constitute a pathway for exposure.

Exhumation and dispersal of contaminated soils by wildlife inhabitants may occur at TA-2 and TA-41; thus, burrowing animals are known biological receptors. Uptake and dispersion of TA-2 and TA-41 contaminated soil by plants also can occur at areas of TA-2 and TA-41 with known soil contamination. Animals using those plants as a food source (e.g., deer and elk) may ingest contaminants with the food.

5.5 Public Health and Environmental Impacts

The Environmental Surveillance Report for studies in 1989 (ESG 1990, 0497) indicates that the DOE Radiation Protection Standard (RPS), under which the Laboratory operates, limits incremental radiation doses (effective dose equivalent) to the general public from all Laboratory operations to 100 mrem/yr from selected pathways. This value includes the air pathway exposure route of 10 mrem/yr in accordance with EPA requirements. For comparison, the average background radiation exposure to individuals living in Los Alamos is approximately 336 mrem/yr (ESG 1990, 0497). TA-2 and TA-41 radiation monitoring stations have never measured radioactivity levels more than 1% (1 mrem/yr) of applicable DOE or EPA guidelines.

The ESG report for environmental surveillance during 1989 estimates that the maximum incremental risk of cancer from radiation to Los Alamos residents as a result of all 1989 Laboratory operations is about 1×10^{-8} (ESG 1990, 0497). Of that risk, the contribution from TA-2 and TA-41 is small.

New data relevant to TA-2 and TA-41 collected during the RFI will be used to further evaluate public health and environmental impacts for the near- and long-term time frames.

5.6 TA-2 and TA-41 Site and Los Alamos Canyon Conceptual Model

This section presents an overview of the development of the conceptual model for OU 1098. This conceptual model is based largely on archival data which was evaluated during preparation of this work plan.

5.6.1 Development of the Conceptual Model

In this section, a site conceptual model of potential contaminant release and transport for this OU and for Los Alamos Canyon is summarized. It is based on present understanding and considerations developed earlier in this work plan. It is presented diagrammatically in Figure 5.6-1 and in summary form in Table 5.6-1. Figures 5.6-2 and 5.6-3 show the relationships among contaminated media, pathways, and receptors within Los Alamos Canyon. The key elements in this model includes the sources, release mechanisms, transport pathways, and representative exposure scenarios for each pathway. These issues and the resulting exposure scenarios relevant to Phase I investigations are presented in Section 5.6.2 and are developed in further detail in portions of Chapter 7, where individual PRSs are described in detail and PRS-specific field investigations are developed.

The PRS-specific and other field investigations for OU 1098 outlined in Chapter 7 are based on conceptual models. Data acquired from Phase I of the RFI will provide information needed to assess conditions at each PRS and background data for OU 1098 for Phase II and thus will refine the conceptual models. Phase I data then provide the basis for initial risk assessment, through comparison with screening action levels (SALs) derived expressly for this purpose. Phase I data also provide the basis for design of any required Phase II investigations, ultimately leading to corrective measures selection. It is expected that assessment of Phase I data for this OU will allow the currently listed PRSs to be reduced to a smaller number to include only those PRSs from which contamination above screening action levels actually has been documented.

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

5.6.2 Development of Exposure Elements of the Conceptual Model

Phase I work plans usually address concerns relevant to exposure potential within the confines of the PRS boundaries. There are several PRSs at OU 1098, however, that are not likely to have discrete boundaries. Those PRSs consist of outfalls into Los Alamos Creek flowing through both TA-41 and TA-2 and the cooling tower drift at TA-2. Investigation of the extent of cooling tower drift may be confined to the boundary of TA-2 during Phase I. It is probable, however, that some of the mist deposited east of TA-2 within the canyon walls and bottom. If contamination of the surface or subsurface soil on TA-2 is

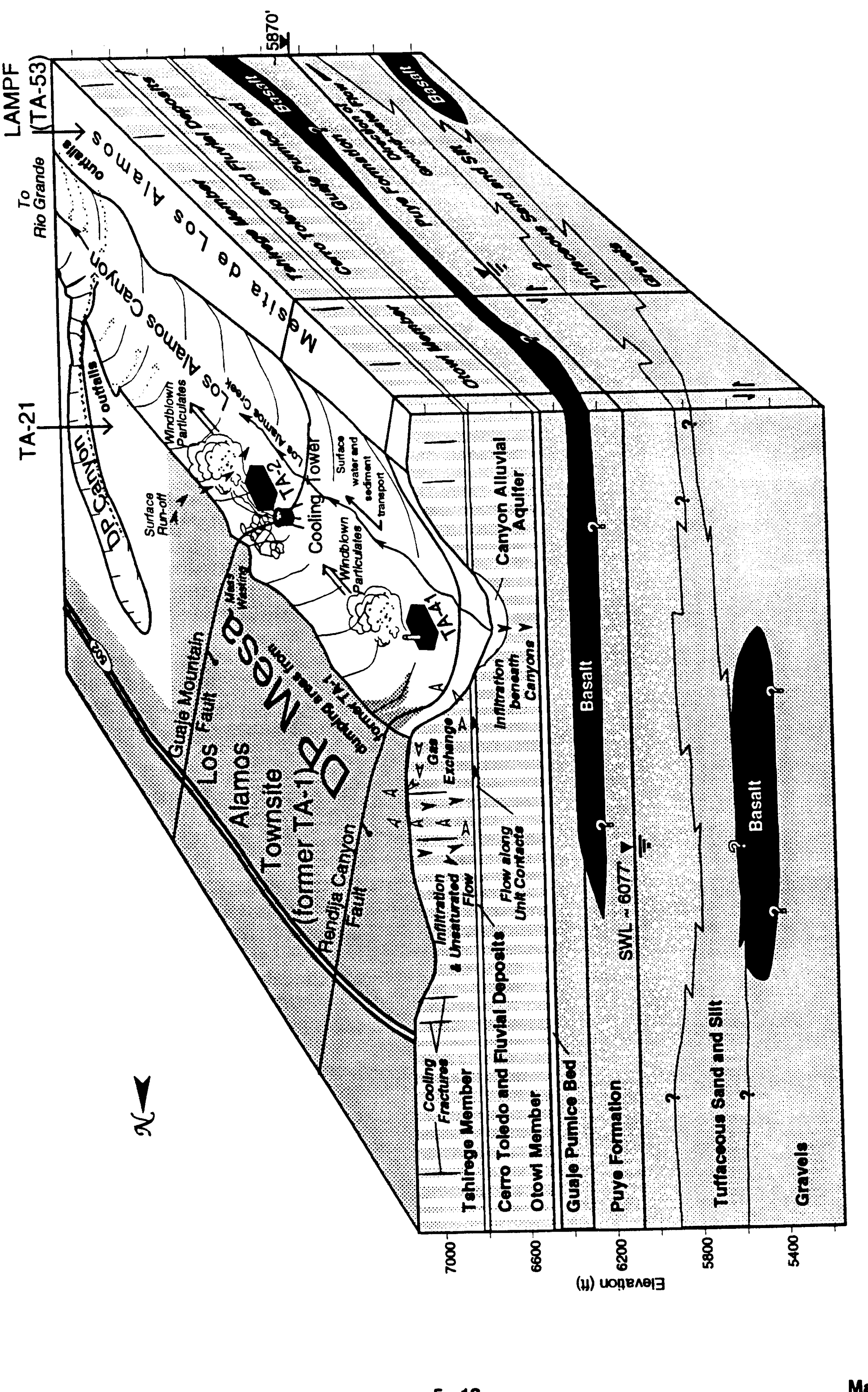


Figure 5.6-1 Three-dimensional conceptual model of TA-2 and TA-41.

TABLE 5.6-1

SUMMARY OF 1098 SITE CONCEPTUAL MODEL ELEMENTS

Pathway/Mechanism	Concepts/Hypotheses
Atmospheric Resuspension	• Entrainment is limited to contaminants in surface soils and sediments. • Entrainment and deposition are affected by soil properties. • Atmospheric conditions affecting entrainment, dispersal, and deposition include wind speed, direction, and stability.
Surface Water Run-Off Surface Water	• Precipitation that does not infiltrate will become surface run-off, or will evaporate, or transpire. • Surface run-off is concentrated by natural topographic features or manmade diversions. • Solution contaminant transport by surface run-off can occur, but mass movement by suspended particles or local bed sediments will dominate. • At the present time, surface run-off is likely to carry contaminants beyond the TA-2 and TA-41 boundary within TA-21.
Floods	• The floor of Los Alamos Canyon is within the 100-yr floodplain.
Soils/Sediments	• Surface soil erosion and sediment transport is a function of run-off intensity, vegetation, topography, and soil properties. • Contaminant movement will be partly retarded by adsorption onto natural organics, clays, and other highly adsorptive phases. • Contaminants adsorbed on surface soils can be transported by run-off and concentrated in sedimentation areas of drainages. • Erosion of drainage channels can extend back to the source area of a SWMU. Thus, adsorbed contaminants may migrate with eroded sediments.
Alluvial Aquifer	• A perennial alluvial aquifer exists in Los Alamos Canyon, which receives contaminants from TA-2 and TA-41.

TABLE 5.6-1 (*continued*)

SUMMARY OF 1098 SITE CONCEPTUAL MODEL ELEMENTS

Pathway/Mechanism	Concepts/Hypotheses
Alluvial Aquifer (*cont.*)	• Surface run-off in Los Alamos Canyon infiltrates into sediments of channel alluvium. • Flow in the alluvial aquifer under saturated conditions will be down-channel and can be represented by a porous medium continuum model. • Water in the alluvial aquifer probably enters the underlying tuff (Otowi Member). The extent of the process will depend on the properties of the interface between the saturated alluvium and unsaturated tuff.
Vadose Zone Transport/Infiltration	• Infiltration into surface soils depends on the rate of rainfall or snowmelt, antecedent soil water status, depth of soil, rate of transpiration, antecedent soil and tuff water content, and soil and tuff hydraulic properties. • Movement of most contaminants by liquids in the unsaturated zone would occur primarily by suspended solids. Tritium migrates in the form of tritiated water. • Infiltration into the tuff depends on the unsaturated hydraulic properties of the tuff. • Joints and fractures in the tuff may provide additional pathways for infiltration to enter the subsurface regime. • Significant unsaturated flow in portions of tuff is likely to be a factor at TA-2 and TA-41.
Saturated Flow	• Steady-state conditions may describe the hydraulic character of the near surface. • Liquid flow in tuff under ambient conditions can be represented by a porous medium continuum model. • A nonflowing condition exists below the influence of transient surface moisture. • Contaminant movement may be partly retarded by adsorption into natural organics, clays, and other adsorptive media in the soils and tuff.

TABLE 5.6-1 (*continued*)

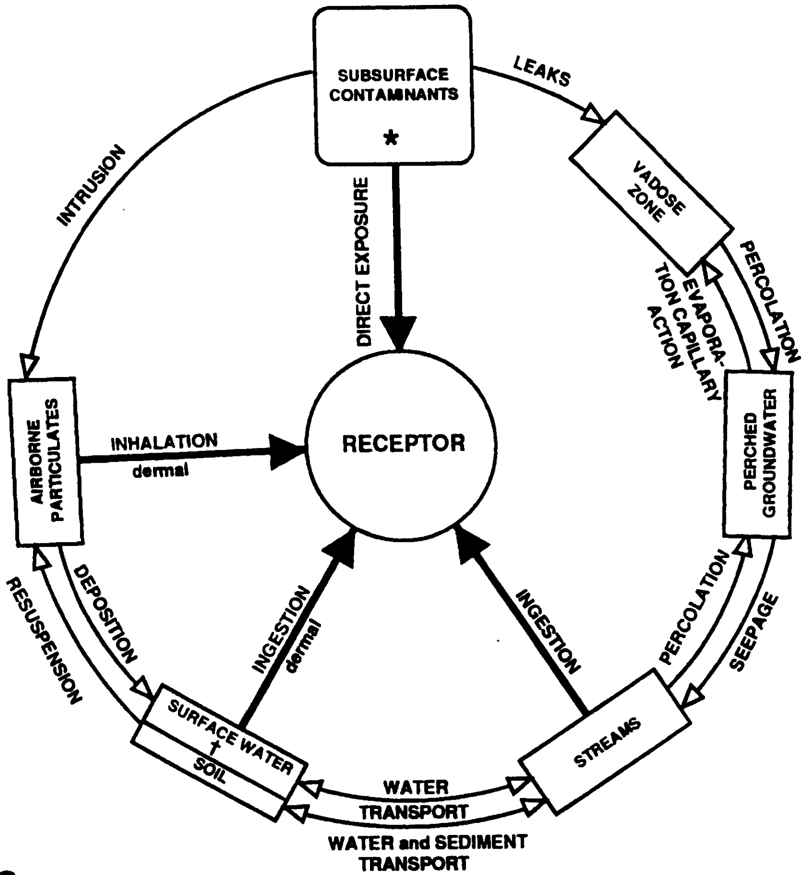
SUMMARY OF 1098 SITE CONCEPTUAL MODEL ELEMENTS

Pathway/Mechanism	Concepts/Hypotheses
Saturated Flow (*cont.*)	• Fractures affect liquid transport. Their role is dependent upon soil water content. Above a critical water content, fractures are expected to facilitate flow and transport. Below the critical water content, only unsaturated flow is significant and rock matrix properties will dominate the hydraulic response.
Vapor Transport	• Vapor-phase processes are not important for any TA-2 and TA-41 contaminants except tritium. • Matrix effects that may influence vapor transport include porosity, permeability, moisture content, and other properties of the soil and tuff. • Exchange of pore gas with atmospheric air is a release mechanism for tritium. Exchange is influenced by temperature gradients and atmospheric pressure changes. • Fractures may facilitate for gas exchange between tuff and the atmosphere.
Lateral Flow at Unit Contacts	• Contrast in hydraulic properties between strati graphic units may divert flow laterally or may cause a perched water zone to develop. • Perched water zones provide localized areas where saturated flow conditions occur.
Erosive Exposure/Soil Erosion	• The erosion of surface soils is dependent on soil properties and vegetative properties, slope and aspect, exposure to wind, and run-off intensity and frequency. • Erosion is controllable by natural and artificial surface features. • Depositional areas as well as erosional areas are determined by the above factors.

TABLE 5.6-1 (*continued*)

SUMMARY OF 1098 SITE CONCEPTUAL MODEL ELEMENTS

Pathway/Mechanism	Concepts/Hypotheses
Mass Wasting	• The loss of rock from canyon walls is a continual, observable process. • The rate of mass wasting may be significant at TA-2 and TA-41 on a very long time frame.
Biological Transport	• Wetlands inhabitants (i.e., consumption of contaminated vegetation by mobile biota) represent the primary biological dispersal mechanism for TA-2 and TA-41 contaminants. • Biologically exhumed material can be dispersed subsequently by surface water, air erosion, and vegetation. • Transpiration of tritium through plant species that have roots extending into the alluvial groundwater may cause the transfer of tritium from groundwater to the air.



NOTES:

* Contaminants that become exposed through assumed excavation and depositing subsurface soil on the surface follow the surface contaminant conceptual model

† Seeps, streams, and temporary water.

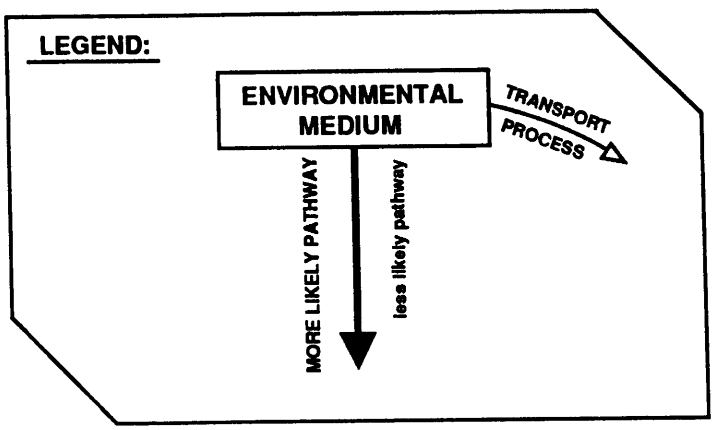
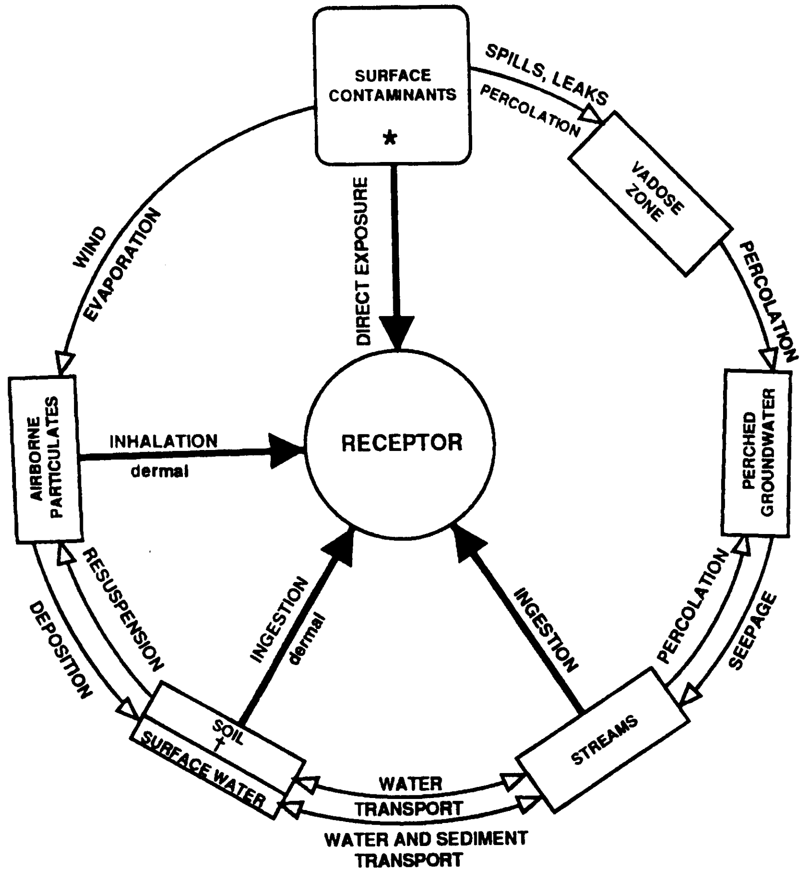


Figure 5.6-2 Conceptual model of subsurface contaminant transport from the TA-2 and TA-41 OU to potential receptors.



NOTES:

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

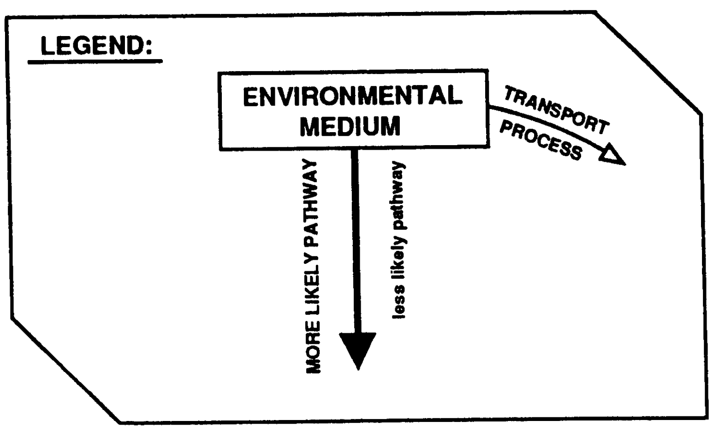


Figure 5.6-3 Conceptual model of surface contaminant transport from the TA-2 and TA-41 OU to potential receptors.

present as a result of cooling tower drift, Phase II investigations may progress off-site until the extent of contamination resulting from deposition of airborne mists have been defined. Identification of releases of liquid wastes from outfalls into the stream system to those areas within the boundaries of OU 1098 is subject to uncertainty as there is a chance that sampling under the outfalls and immediately downstream might not result in a representative sampling. The stream reaches within the boundaries of OU 1098 are subject to scouring during heavy precipitation events, thus increasing the possibility that any contaminants discharged from the outfalls have been displaced further downstream to the first major sediment depositional area. In addition, the stream segment at the outfalls is subject to periodic dredging to remove accumulated sediments. To ensure that a false negative result is not obtained when the outfalls are being investigated, stream sampling will include the first major sediment depositional area downgradient, but outside, of the eastern boundary of TA-2, as well as other transect areas (see Section 7.2 baseline sampling).

Development of the conceptual model useful to preparation of the baseline risk assessment for the site requires that potential current and future exposure scenarios be identified for OU 1098. For purposes of the baseline risk assessment, exposure evaluation of PRSs within OU 1098 will include consideration of exposure potential to both humans and wildlife.

For purposes of the Phase I investigation presented in this work plan, the conceptual exposure model has been defined in the IWP (Chapter 4, LANL 1992, 0768) as theoretical exposure of a resident to soil and groundwater. Discussion of how the residential or recreational exposure scenario relates to the overall conceptual exposure model for the Operable Unit is presented in the text to follow.

As stated in Section 4.1.3 of the IWP, investigations to support risk assessment generally require samples that are representative of the exposure units and contact media corresponding to the land use scenario and exposure routes for which risk is to be estimated. Sample data in the Phase I investigation are being collected for comparison with SALs derived for theoretical exposure of a resident, although the statement is made in Section 4.3.3 of the IWP that "for most PRSs located on Laboratory property, continued commercial/industrial use and eventual release of these lands for recreational use (e.g., camping) is assumed." In the interim, SALs based on residential exposure were chosen for Phase I data comparisons because that scenario is likely to represent the most sensitive human population and, therefore, yield the most stringent SALs of any of the land use scenarios. Screening action levels are derived from conservation exposure assumptions as described in subpart sand are used for screening purposes. The actual assumptions are likely to be a combination of continued-Laboratory operations and recreational use.

Although the ultimate use of the land could be for purposes other than residential use, the data gathered during the Phase I investigation of OU 1098 will be important to any future land use scenario that may be envisioned for the Laboratory property. Thus, it is not necessary to have already formulated exposure scenarios for future land use for purposes of designing a Phase I sampling strategy. The reason is that the various environmental media that could become contaminated are limited and are largely important to exposure scenarios pertinent to a wide variety of receptors. The environmental media that could become contaminated are soil, air, surface water, sediments, and groundwater.

The presence of chemical contaminants in surface and subsurface (to 12 ft in depth) soils data may be applied in all evaluations of risk, be they human-oriented or ecologically oriented. Human exposure to soils, regardless of the type of receptor (i.e., resident, worker, recreational, or agricultural users of the land), may occur through ingestion, dermal contact, and inhalation of soil in the form of dust. Additional exposure pathways may occur to residential and agricultural users through use of the land to grow food for direct consumption or for indirect consumption (i.e., through growth of animal feed and subsequent consumption of the animals). Although dust exposure occurs by way of air, it is important to recognize that the source of contaminated dust is most likely to be the soil. Also, there is an exposure potential to chemical vapors that might be emanating from the soil. Again, vapor exposure of relevance to the ER Program largely occurs as a result of contaminated soil even though the exposure is occurring by way of the air.

Characterization of soil as a contaminated environmental medium is equally important in ecological risk assessments. Virtually any plant and animal exposure model will include exposure to soil. To illustrate, exposure to terrestrial animals will occur through ingestion of plants that grow in contaminated soil. The plants take up many of the contaminants that occur in soil or contaminated dust settles on the plant itself. Also, many animals incidentally ingest soil as a part of their diet, have dermal contact with contaminated soil, and breathe in dust and vapors just as do humans. Therefore, soil sample data gathered during Phase I investigations has utility in the screening risk evaluation (i.e., comparison of the soil with SALs) and in any baseline risk assessment that might be prepared, regardless of land use scenario.

Surface water and sediments also are important media in the evaluation of risk to any human or ecological receptor and, therefore, must be evaluated for any future land use scenario. To illustrate, the important surface water exposure pathways to humans or to terrestrial wildlife are ingestion of the water, dermal contact with the water and sediments, and consumption of contaminated foods that were produced in the water. Residents and commercial users of the land containing contaminated surface water and sediments can contact the water and sediments through play (residents) and through maintenance activities (e.g., workers mowing grass at the water's edge or installing a utility line across a stream channel), or through ingestion of fish (residents and workers), provided that the water system is large enough to support fish. In the agricultural setting, livestock may water in the stream and may ingest contaminated vegetation rooted in the contaminated water/sediment. Terrestrial wildlife may contact the water and sediments by crossing streams, drinking water from the streams, and eating plant and animal life found in the stream. When aquatic plant and animal life are considered, it is obvious that characterization of water quality is critical to the evaluation of risk to the aquatic ecosystem.

Groundwater quality is an important consideration to any human exposure scenario, as residents, workers, and agricultural users may ingest contaminated groundwater or ingest plant matter or meat that was produced with contaminated groundwater. Recreational users of land and wildlife can become exposed to contaminated groundwater if that water discharges to the surface (i.e., the stream exposure pathways apply). Thus, groundwater quality can be very important to evaluation of risk to humans and wildlife (when the water discharges to the surface).

At OU 1098, the environmental media subject to investigation under Phase I include soil, surface water, sediments, and groundwater. The results of the soil and groundwater data collection activities performed during Phase I will be compared with available SALs, based on a residential use scenario, derived for soil and groundwater, and presented in Appendix J of the IWP. For surface water quality comparisons, the groundwater SALs will be applied according to Section 4.2.2.1 of the IWP. There is no guidance presented in the IWP regarding SALs for sediments; as a default, the SALs for soils will be used.

Although the SALs developed for use in the ER Program at LANL reflect a residential use scenario, the intent of the preceding text was to illustrate that the data collected during Phase I investigations may be applied to virtually any land use scenario that might be decided is appropriate for conduct of the baseline risk assessment (human and ecological).

5.6.2.1 Phase I Data Needs for Human Health Risk Assessment

For purposes of a preliminary assessment of impact potential to human health, Phase I efforts should be directed toward characterization of the nature, magnitude, and extent of the presence of selected RCRA Appendix VIII (40 CFR 261, Appendix VIII) chemical substances and radionuclides within OU 1098 and the first major sediment depositional area east of TA-2. The results of Phase I sampling will be compared with SALs, included in the IWP (LANL 1992, 0768) that represent risk potential to humans.

5.6.2.2 Phase I Data Needs for Assessment of Ecological Risk

Baseline risk assessment of ecological impact potential within Los Alamos Canyon requires an evaluation of the environmental media affected. The media that are important in assessing risk potential posed to wildlife include soil, surface water, and sediment. Although a strategy for assessment of ecological impact potential is yet to be developed, there is a need for the same environmental sample data as that needed for assessment of risk potential to humans. Other sample data may be gathered during Phase II; the ecological risk strategy requires additional information.

5.6.2.3 Summary of Elements of the Conceptual Model

Key considerations in the OU 1098 site conceptual model are summarized in the following paragraphs.

Land use/time frame assumptions. Under current land use patterns in the vicinity of TA-2 and TA-41, pathways or receptors are of significant concern over the 100-yr time frame assumed for institutional control. Contaminant migration within the alluvial aquifer occurs to the east of OU 1098, and it is probable that the sources of contamination are present within TA-2 and TA-41. In addition, if land use patterns change in the future for recreational use (e.g., land transfer to BNM or NPS), or if dramatic climactic changes occur, some primary long-term exposure pathways such as infiltration or intrusion may need continued investigation.

Flooding potential. Because TA-2 and TA-41 buildings lie within Los Alamos Canyon, flooding has been investigated as a potential environmental problem. The characteristics of the drainage basin indicate that a 100-yr flood event would result in a flow of 26 m^3/sec (902 ft^3/sec). Flooding of parking lots and roadways may occur in such an event, particularly if the channel were to become clogged with debris. Based on the "worst-case" scenario of a 100-yr storm event, some shallow flooding of permanent buildings may occur, but would not be widespread.

Conditional remedy/corrective measures. As discussed earlier in this work plan, it is probable that the remedy of soil excavation (EPA 1990, 0432), as corrective measures (as appropriate) over time, will be found to be the most appropriate remedial action for portions of TA-2 and TA-41.

Erosional processes. Exposure of TA-2 and TA-41 near-surface units by erosion and consequent transport by run-off is an observed pathway (ESG 1990, 0497). Thus, the identity, quantity, and distribution of surface and near-surface contamination will be investigated in Phase II of the RFI, if required. In addition, the roles of precipitation run-off and soil erosion and the subsequent movement and fate of water and contaminants at TA-2 and TA-41 at other portions of Los Alamos Canyon will be investigated. Although aeolian processes represent another erosional pathway to be addressed, they are probably of less significance than the surface-water pathway. Canyon retreat processes may affect the long-term stability of the buildings at TA-2 and TA-41. These investigations will start after sediment data have been collected and interpreted from the adjacent OUs to Los Alamos Canyon. This approach will help in locating and collecting the most relevant sediment data.

Infiltration. Transport from surface water through the unsaturated zone to the groundwater (alluvium, hypothetical perched aquifer in the basalt-Puye Formation) is the pathway of immediate concern at TA-2 and TA-41, the concern being based on the shallow depth to the uppermost alluvial aquifer and on past site characterization, which indicate the presence of credible groundwater pathways. The hydraulic conductivities of the Guaje Mountain and Rendija Canyon faults are not known and these two faults represent potential conduits of recharge of the main aquifer, provided that these faults are not cemented with fine-grained material. Over long time frames, these fracture systems probably represent potential pathways that must be considered for transport of buried contaminants by infiltration of surface water.

Biological activity. The uptake of contaminants by wetland inhabitants (vegetation included) may occur at TA-2 and TA-41. The environmental significance of this activity will be addressed during Phase II of the TA-2 and TA-41 RFI.

Human intrusion. For purposes of the Phase I investigation, accidental or deliberate human intrusion into surface and subsurface units represents a possible exposure scenario.

Food chain. The food chain is considered to be a realistic pathway for areas within Los Alamos Canyon because of observed groundwater and surface water transport of contaminants east to OU 1098. Sampling of environmental media in areas other than the first major sediment deposition area below TA-2 and TA-41 will be addressed at a later date after Phase I data have been evaluated to investigate the potential for contaminant uptake by plants and animals resident in the area.

Receptors. Human receptors of relevance to this Phase I investigation consist of residents assumed to live on the PRSs. Residential use is assumed for purposes of evaluation of alluvial groundwater in the vicinity of the PRSs. Investigation of alluvial groundwater quality in areas farther east of OU 1098 will be conducted, if warranted, during the Phase II investigation.

5.6.3 Conceptual Model Refinement

Additional site characterization data will enable further refinement of the conceptual model by providing data that test the current model. Data obtained during this RFI as well as new results from other OUs adjacent to Los Alamos Canyon, the ER Program's Framework Studies, and the Laboratory's Environmental Surveillance Group (ESG) will be integrated in updated models.

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

5.7 Summary of General Data Needs

Table 5.7-1 summarizes the overall data needs for OU 1098 as generated from discussions of available information in Chapters 4 and 5. The field sampling plans in Chapter 7 explicitly describe the plan by which the required data will be acquired.

TABLE 5.7-1

SUMMARY OF GENERAL DATA NEEDS FOR THE 1098 OU RFI.

Objective	Data Needs
Site Hydrology	
1. Characterize stratigraphic properties related to potential contaminant transport pathways at TA-2 and TA-41	• Locations for subsurface characterization • Borehole cores and lithologic logs to confirm depths and nature of rock unit contacts
2. Determine site physical, mineralogical, and hydrological properties important to unsaturated transport	• Physical, hydrologic, chemical, and mineralogic analysis of soils, tuff, and fill material in fractures and joints • Downhole borehole logs to identify changes in mois ture, density, and mineralogy with depth • Retardation factors for key contaminants with TA-2 and TA-41 tuff and soil • Tracer studies to determine recharge flux • Moisture content and flux in bulk tuff, soils, and fill materials
3. Characterize role of joints and fractures as barriers or pathways for contaminant migration	• Maps of fracture density patterns mainly surface exposures, and possibly from cores, boreholes, and pits. • Hydrogeochemical characterization of filling materials • Characterization of impermeable zones and areas with elevated moisture
Site Morphology	
1. Identify surface geology, unit contact expressions, and paleoerosional surfaces	• Geologic map of TA-2, and TA-41 and other OUs adjacent to and within Los Alamos Canyon, based on exposed units in Los Alamos Canyon and bore hole data

TABLE 5.7-1 (*continued*)

SUMMARY OF GENERAL DATA NEEDS FOR THE 1098 OU RFI

Objective	Data Needs
Site Morphology (continued)	• Map of erosional and depositional areas and drainage pathways • TA-2 and TA-41 fault map from field examination, seismology, and corings
Contaminant Identification and Quantification	
1. Quantify contaminants at each SWMU	• Level II/III/IV field and laboratory analyses • Analyses for chemical and radiological contaminants in soil, surface water, sediments, and shallow groundwater
Contaminant Migration	
1. Identify any migration of contaminants at each SWMU	• Rates, frequency, and volumes of surface erosion and mass wasting events • Verification of release points • Development of K_ds specific to OU 1098
Phase I Risk Evaluation	
1. Assess contaminant levels against human health-based screening action levels.	• Soil and tuff background levels for TA-2 and TA-41 contaminants • Identify and quantify chemical and radiological constituents in soil (subsurface included), surface water, sediments, and shallow groundwater • Sample analyses along preferential migration paths at first downgradient major sediment depositional point in Los Alamos Creek.

TABLE 5.7-1 (*continued*)

SUMMARY OF GENERAL DATA NEEDS FOR THE 1098 OU RFI

Objective	Data Needs
	• Mobile contaminant identification by way of sampling at first major sediment depositional area in Los Alamos Creek. • Exposure points for each major pathway of relevance to Phase I studies.
Potential Remedial Alternatives	
1. Assess potential remedial measures	• Determine, from comparison of site data with screening action levels, whether COCs are present. If not, evaluate for NFA. If so, evaluate for potential remedial measures. • Data and analysis regarding effectiveness of each likely remedial alternative • Identification of pathways to be blocked, exposure scenarios, and land use scenarios • Evaluation of ease of implementation, long-term effectiveness, and cost

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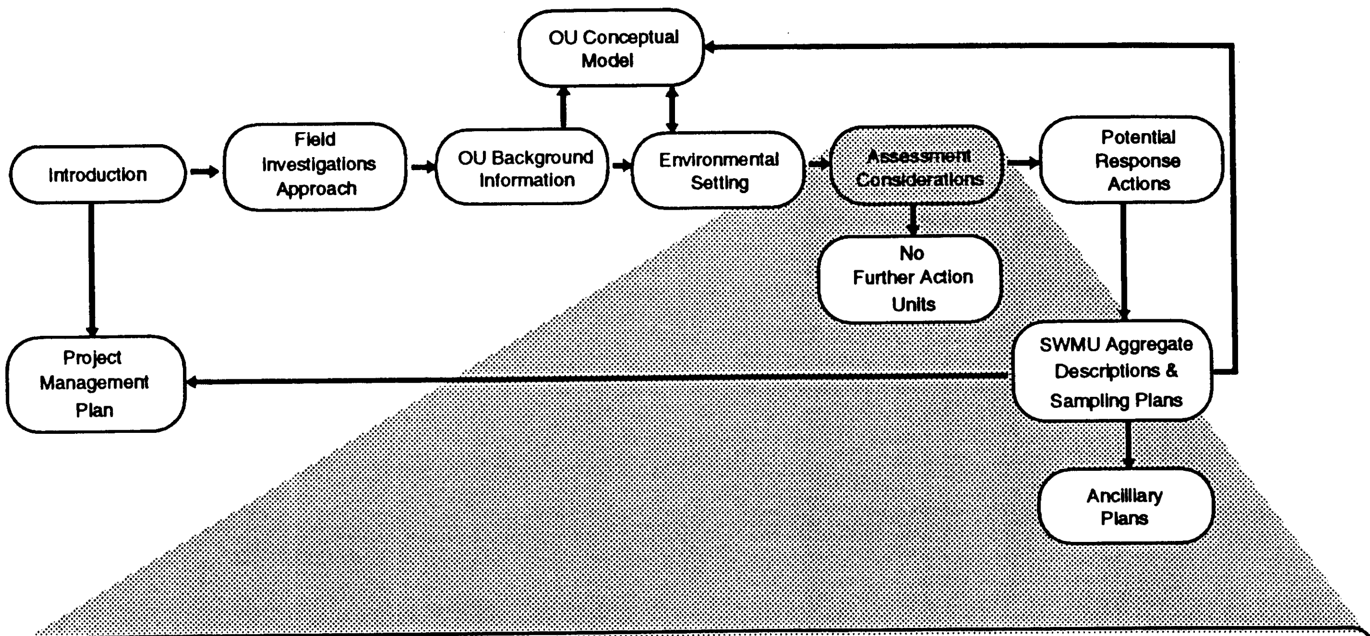
Chapter 6



Assessment and Remedial Considerations and Data Quality Objectives

- Screening Action Levels and Background Concentrations
- Applicable Relevant and Appropriate Regulations
- Potential Remedial Actions
- Decision Process
- DQO Process
- Field and Analytical DQOs

6.0 ASSESSMENT AND REMEDIATION CONSIDERATIONS AND DATA QUALITY OBJECTIVES

This chapter contains a discussion of assessment and remediation considerations pertinent to the development of this operable unit (OU) work plan and Los Alamos Canyon. Areas of investigation within Los Alamos Canyon for this RFI are within the 1-mi segment of Los Alamos Canyon encompassing OU 1098 [Technical Area-2 (TA-2) and TA-41]. This investigation will be coordinated with investigations of other OUs which include parts of Los Alamos Canyon (e.g., the Canyons OU and OU 1106). Sections of Chapter 6 are listed below.

- 6.1 Screening Action Levels and Background Concentrations
- 6.2 Applicable, Relevant, and Appropriate Regulations
- 6.3 Potential Remedial Actions
- 6.4 Decision Process
- 6.5 Data Quality Objectives Process
- 6.6 Field and Analytical Data Quality Requirements

The information described under these sections, combined with the environmental setting and conceptual model discussed in Chapter 4 and 5, leads directly to the potential release site (PRS)-specific field characterization plans in Chapter 7 and the recommendations for no further action (NFA) in Chapter 8.

6.1 Screening Action Levels and Background Concentrations

6.1.1 Definitions

Screening action levels (SALs) represent decision criteria used to determine whether further action may be required at potential or known release sites. The philosophy underlying the application of SALs is described in proposed Subpart S to 40 Code of Federal Regulations (CFR) 264 and in Section 4.2.2 of the Installation Work Plan (IWP) (LANL 1992, 0768). For areas where SALs are exceeded, further investigation of the PRS may be required, although remedial action ultimately may not be necessary.

In this OU work plan, SALs are preset soil, water, and air concentrations that are at or below the most conservative action levels likely to be set for the PRSs.

Background levels are the levels of radiation and metal/elemental concentrations that occur naturally (or at fallout levels, in the case of some radionuclides) in site media (Purtymun et al. 1987, 0211).

6.1.2 Indicator Contaminants

Past site activities involving hazardous and radioactive materials at TA-2 and TA-41 were associated with reactor research and weapons-related experiments, respectively, from 1944 to the present. Selected analyses for radionuclides and Resource Conservation and Recovery Act (RCRA) metals and organic compounds will be performed during Phase I and Phase II investigations to identify contaminants of concern (COCs) and to define potential contaminant distributions in soil, sediment, Bandelier Tuff, surface water, and groundwater. Radioactive constituents including tritium, fission products, uranium, and plutonium, organic compounds, and chromium, mercury, and other metals are known or suspected to be present in soils and sediments at TA-2. Similarly, radioactive constituents including tritium, uranium, and plutonium, organic compounds, and beryllium, lead, mercury, and other metals may be present at TA-41. In many circumstances, however, it is appropriate to select a set of indicator constituents that can be used to limit the number of analyses required to assess any given PRS. TA-wide indicator constituents were identified based on archival data suggesting their possible presence over larger areas of the TA (i.e. at several PRSs). The primary indicators for TA-2 contamination are the following:

- Tritium,
- Cesium-137,
- Strontium-90,
- Technetium-99,
- Cobalt-60,
- Mercury,
- Chromium (hexavalent and total),
- Total uranium and isotopic plutonium, and
- Gross-alpha/beta, and gross-gamma radioactivity.

The primary indicators for TA-41 contamination are the following:

- Tritium,
- Beryllium,
- Lead,
- Mercury,
- Total uranium and isotopic plutonium, and
- Gross-alpha/beta, and gross-gamma radioactivity.

Additional primary indicators may be added to these lists for PRS-specific investigations based on site-process knowledge.

6.1.3 Screening Action Levels

Table 6.1-1 lists background concentrations and available SALs for OU 1098 indicator contaminants in soils, sediments, surface water, and groundwater. These SALs, presented in Appendix J of the IWP, apply to unrestricted site use and are based on extremely conservative exposure criteria such as residential use. The SALs for radioactive constituents are based on a 10mrem/yr dose in

TABLE 6.1-1

SCREENING ACTION LEVELS, BACKGROUND LEVELS, ANALYTICAL METHODS, AND DETECTION LIMITS FOR TA-2 AND TA-41 OU INDICATOR CONTAMINANTS

Indicator Contaminant	Soil SALs[a]	Groundwater SALs or CGDW[a]	Background Level[b]		Practical Quantitation Limit[c]		Analytical Method
			Soil	Sediment	Soil	Water	
Beryllium	0.16 µg/g[c]	0.0081 µg/L	1.9 µg/g	------	0.06 µg/g	0.3 µg/L	SW 846 6010
Total uranium	240 µg/g	100 µg/L	3.8 µg/g	3.2 µg/g	0.5 µg/g	20 µg/L	ICP
Cesium-137	4 pCi/g	120 pCi/L	0.72 pCi/g	0.71 pCi/g	0.1 pCi/g	20 pCi/L	Gamma spectrometry
Gross gamma	(d)	(d)	2.0 pCi/g	5.1 pCi/g	0.1–2 pCi/g	-----	Gamma spectrometry
Plutonium-238	27 pCi/g	1.6 pCi/L	0.104 pCi/g	0.004 pCi/g	0.01 pCi/g	0.04 pCi/L	Alpha spectrometry
Plutonium-239	24 pCi/g	1.2 pCi/L	0.092 pCi/g	0.004 pCi/g	0.01 pCi/g	0.04 pCi/L	Alpha spectrometry
Gross alpha	(d)	15 pCi/L	--	--	10 pCi/g	5.0 pCi/L	Gas-flow proportional counter
Gross beta	(d)	50 pCi/L	--	--	12 pCi/g	6.0 pCi/L	Gas-flow proportional counter
Chromium(VI)	400 µg/g	50 µg/L	ΣCr 27 µg/g[e]	--	ΣCr 1.4 µg/g[e]	7 µg/L	SW 846 6010
Chromium(III)	80,000 µg/g	50 µg/L	ΣCr 27 µg/g[e]	--	ΣCr 1.4 µg/g[e]	7 µg/L	SW 846 6010
Tritium	(d)	20000 pCi/L	--	500 pCi/g	400 pCi/g	400 pCi/L	Liquid Scintillation
Cobalt-60	0.9 pCi/g	(d)	--	---	2.0 pCi/g	300 pCi/L	Gamma spectrometry
Lead	500 µg/g	50 µg/L	24 µg/g	---	1.2 µg/g	1 µg/L	SW 846 7421
Mercury	24 µg/g	2 µg/L	.018 µg/g	---	0.2 µg/g	0.2 µg/L	SW 846 7470, 7471

TABLE 6.1-1 (continued)

SCREENING ACTION LEVELS, BACKGROUND LEVELS, ANALYTICAL METHODS, AND DETECTION LIMITS FOR TA-2 AND TA-41 OU INDICATOR CONTAMINANTS

Indicator Contaminant	Soil SALs[a]	Groundwater SALs[a] or CGDW	Background Level[b]		Practical Quantitation Limit[c]		Analytical Method
			Soil	Sediment	Soil	Water	
Technetium-99	(d)	(d)	--	---	---	---	Gamma spectrometry
Strontium-90	8.9 pCi/g	40 pCi/L	--	---	2.0 pCi/L	3.0 pCi/L	Gas-flc roportional counter

a SALs refer to levels above background, not total concentration. SALs are taken from Appendix J, Tables J–I and J–2, of the IWP, from Annex II of this work plan. Groundwater values for radionuclides and metals, are taken from DOE's calculated guides for drinking water (CGDW) (see Table 4.4-2).

b Soil and sediment background levels for radionuclides are taken from Table G-33 of the report on the 1989 ESG surveillance program (ESG 1990, 0497). The values given are maximum observed values. Background values for metals are taken from Ferenbaugh et al. (1990, 0099). Background levels in surface water were not available.

c Practial quantitation limits and methods are as specified in the Generic QA Project Plan and in Annex II and Appendix C of this OU work plan.

d SALs for select constituents have not yet been determined.

e Analyses for Cr do not distinguish between Cr(III) and Cr(VI). Analytical levels are listed for total Cr.

excess of background for total radioactivity for a residential scenario (LANL 1993).

The proposed SAL for uranium, based on toxicity, in surface soil is 240 ppm (Table J-1, IWP LANL 1992, 0768). This concentration level is higher than the SALs based on radioactivity for individual uranium isotopes (8.6 ppm or 18 pCi/g for U-235, and 180 ppm or 59 pCi/g for U-238). Transuranic (TRU) waste, such as plutonium may be present at TA-2. SALs based on radioactivity for plutonium isotopes in surface soil range from 24 to 27 pCi/g.

6.1.4 Radioactivity Screening Levels

Screening and survey techniques for radioactive constituents in soils and subsurface samples will be used heavily during this RCRA Facility Investigation (RFI). Appendix F of this OU work plan describes hand-held and tripod-mounted survey instruments and the vehicle-based spectrometry systems that may be used for radiological surveys. These systems detect gamma and low-energy X-ray emissions characteristic of TRU, fission products, and uranium over the energy range 10 keV to 2.0 MeV. A "radioactivity screening level" of greater than two standard deviations from the mean radiation level detected in the vicinity of OU 1098 will be used to define areas of anomalous radioactivity. This "radioactivity screening level" will be used as a criterion for sampling areas of anomalous radioactivity and for guiding other aspects of the field investigation. However, it is not intended to act as an SAL; laboratory analyses of soil samples will provide quantitative data necessary for this RFI.

6.2 Applicable, Relevant, and Appropriate Regulations

Module VIII of the RCRA permit establishes Corrective Action Requirements (CARs). Task IV, Investigative Analysis, specifies that the permittee must identify all relevant and applicable standards for protection of human health and the environment. Task VI, Identification and Development of the Corrective Action Alternative or Alternatives, further specifies that the permittee must identify, screen, and develop alternatives for removal, containment, treatment, and/or remediation of contamination and must base these actions on the results of the RFI and objectives established for corrective action. Cleanup requirements can be divided into three categories:

- Contaminant-specific requirements that address specific contaminants,
- Location-specific requirements that are based on a specific site setting, and
- Action-specific requirements associated with specific response actions.

In the absence of more information about contaminant types and concentrations at the PRSs being investigated in this OU work plan, the identification of CARs at this time would be premature. The full tabulation of location-specific, contaminant-specific, and action-specific requirements will be provided in future phase reports as adequate PRS information is obtained through the RFI process.

6.3 Potential Remedial Actions

This section discusses potential remedial actions that may be considered at OU 1098. Consideration of possible remedial action helps define the sampling strategy for a particular PRS. For example, to assess the potential for institutional control of SWMU 2-009 where Cs-137 is known in elevated activities in soil below the water table, the sampling strategy includes data collection downgradient of the SWMU to determine if contamination is leaving the site.

6.3.1 General

In the observational approach, an attempt is made to identify the most likely remedial actions ultimately to be carried out at the OU, given the current state of understanding of the release sites, so the RFI/CMS can be focused. In this section, potential response actions for TA-2 and TA-41 PRSs are discussed. Tables 6.3-1 and 6.3-2 summarize possible reasonable remedial measures for each PRS, except for long-term institutional control. This RFI is designed, where appropriate, to obtain information for preliminary evaluation of these alternative remedial measures. The final selection of remedies will use data gained from the RFI/CMS process and will be based on risk assessment.

For some PRSs at OU 1098, it is quite likely that cumulative releases above SALs, currently set at very conservative levels, will not be found in the RFI. In this case, no further action (NFA) may be proposed. Final evaluation of NFA may warrant consideration of human-health and ecological risk assessment, and consideration of ALARA principles for radiological constituents. For other PRSs, only minor remedial actions, such as removal of surface soils and subsequent revegetation, are likely to be required.

6.3.2 Potential Remedial Actions at TA-2 and TA-41

Phase I and Phase II sampling of OU 1098 is designed to determine the extent of contamination so that reasonable remedial actions may be evaluated during the CMS (if necessary). Selective near-surface soil and borehole sediment samplings are proposed in Phase I to facilitate site characterization at TA-2 and TA-41. An iterative evaluation of potential alternative measures to remove contaminants will be performed to support the Phase II activities for some PRSs. Soil and sediment excavation is a viable remedial action for those PRSs present at OU 1098 where the distribution of contaminants is localized. Emplacement of a downgradient, permeable, geochemical barrier designed to capture contaminants adsorbed onto sediments transported by run-off from TA-2 and TA-41 will be considered during Phase II of the RFI. Alternatively, long-term institutional control may be the most appropriate action for some PRSs. Due to the presence of the near-surface alluvial aquifer and a surface

TABLE 6.3-1

MOST PROBABLE REMEDIAL ACTIONS FOR TA-2 SWMUs BASED ON CURRENT INFORMATION AND HYPOTHESES

SWMU No.	Location	Description	Probable Remedial Action
2-001	TA-2	Burn site	NFA
2-002	TA-2	Inactive storage area	NFA
2-003	TA-2	Decommissioned reactor waste units	Removal of contaminated soil; revegetation
2-004	TA-2	Storage pits and tanks of Omega West Reactor	Removal of contaminated soil and structures; revegetation
2-005	TA-2	Cooling tower drift	Removal of contaminated soil; revegetation
2-006	TA-2	Drains	Removal of contaminated soil and lines; revegetation; geochemical barrier
2-007	TA-2	Decommissioned septic system	Removal of contaminated soil and structures; revegetation, geochemical barrier
2-008	TA-2	Outfalls	Removal of contaminated soil and lines; revegetation, geochemical barrier
2-009	TA-2	Operational releases	Removal of contaminated soil; revegetation
2-010	TA-2	Chemical shack waste units	Removal of contaminated soil; revegetation
2-011	TA-2	Storm drains and outfalls	Removal of contaminated soil and lines; revegetation, geochemical barrier
2-012	TA-2	Potential soil contamination under former tanks	Removal of contaminated soil, revegetation; long-term monitoring if required
2-013	TA-2	Storage area	NFA

TABLE 6.3-2

MOST PROBABLE REMEDIAL ACTIONS FOR TA-41 PRSs BASED ON CURRENT INFORMATION AND HYPOTHESES

SWMU No.	Location	Description	Probable Remedial Action
41-001	TA-41	Septic tank	Removal of contaminated soil and tank
41-002	TA-41	Sewage treatment	Removal of contaminated soil and structure
41-003	TA-41	Sump	Removal of contaminated material
41-004	TA-41	Container storage	NFA

stream, stabilization in place or *in-situ* treatment are not likely to be viable remedial alternatives although they may be considered at selected PRSs depending on site conditions. Voluntary corrective actions will be carried out as appropriate, as discussed in Section 2.10 of this OU work plan.

6.3.2.1 Long-Term Institutional Control

For TA-2, the preferred remedial action for some of the PRSs (for example, possibly SWMU 2-004) identified by the RFI/CMS may be the conditional remedy of long-term institutional control accompanied by soil excavation (where feasible), site stabilization, monitoring, and additional corrective action as required.

6.3.2.2 Excavation and Removal

The preferred remedial action for most PRSs at TA-2 and TA-41 is likely to be soil excavation and removal, followed by backfilling with noncontaminated materials to control erosion and infiltration. Selective removal of contaminated soil may be carried out as voluntary corrective actions (VCAs) during the RFI/CMS.

Excavation, however, may incur a short-term risk of generating minor hazards for on-site personnel. Therefore, short-term risks associated with site excavation will be assessed in accordance with EPA guidance (EPA 1991, 0658).

6.3.2.3 Permeable Geochemical Barrier

The RFI may suggest that construction of a permeable geochemical barrier downgradient from TA-2 and TA-41 is a viable technique to remove contaminants from suspended sediments within Los Alamos Canyon. A geochemical barrier consisting of highly sorptive materials, e.g., ferric oxyhydroxides, zeolites, or sphagnum peat, could be designed to remove radionuclides and other contaminants sorbed onto suspended sediments migrating downstream in Los Alamos Creek. Such barriers are permeable to fluid flow and essentially act as ion exchangers. The optimal design of a barrier would allow for complete capture of the contaminants, although barrier materials may be periodically replaced as their capacity is approached, if costs or other factors preclude a single barrier. A permeable barrier would preclude the build-up of ponded water, which could represent a recharge zone to the alluvial aquifer. Studies conducted by Longmire et al. (1991, 0884) have shown that sphagnum peat removed elevated concentrations of uranium and other metals present in acidic-uranium mill tailings and associated leachates by 95% or more at concentration levels below EPA soil standards.

6.3.2.4 Other Remedial Options

Potential alternative remedial options will be considered during the Phase I investigation. Options may include pump-and-treat scenarios, in-place stabilization, or *in situ* treatment, depending on contaminant and site conditions.

6.4 Decision Process

All PRSs within this OU are evaluated by the decision process illustrated in Figure 6.4-1. This process is modified after the generic decision flowchart for an RFI shown in Figure 4-1 of the IWP (LANL 1992, 0768). Terms used in this diagram are defined in Table 6.4-1. Each of the six diamonds in the diagram represents a point at which a decision is or will be made for each PRS under consideration. To ensure simplicity in the process, three possible answers – don't know, yes, or no – may exist for each question. The process is designed to identify those PRSs that can be recommended for NFA as early in the process as possible and with the least expenditure of resources or, alternatively, to identify PRSs for corrective action as early in the process as possible. Thus, as outlined in the IWP, archival data may be used to proceed to baseline characterization without Phase I investigation, if the data set provides in-depth insight into the nature and extent of contamination. However, information available at present is not considered to be adequate to allow efficient design of a Phase II investigation for an OU 1098 PRS. Those PRSs that cannot be recommended for NFA after Phase I and Phase II investigations and risk assessment have been completed will be candidates for a CMS. Candidate PRSs for VCA/IA (interim action) will be identified as appropriate within the process. Criteria for identifying and handling PRSs that are candidates for VCA/IA are expected to be developed outside of the scope of the RFI.

A more detailed discussion of the technical approach for this RFI, which amplifies the general process flow illustrated in Figure 6.4-1, appears in the following subsections.

6.4.1 Decision Point 1

Is the PRS part of an active site?

An active PRS represents a site that is used by the operating groups at the Laboratory on a continuing basis or is a utility either in use or in the process of being deactivated. If the PRS is an active site, or if it is an inactive site that cannot be characterized without disrupting activities at an active site, then the DQO process leads to Decision Point 2. If the PRS is not associated with active operations, then the decision process proceeds to Decision Point 3 (see Section 6.4.4).

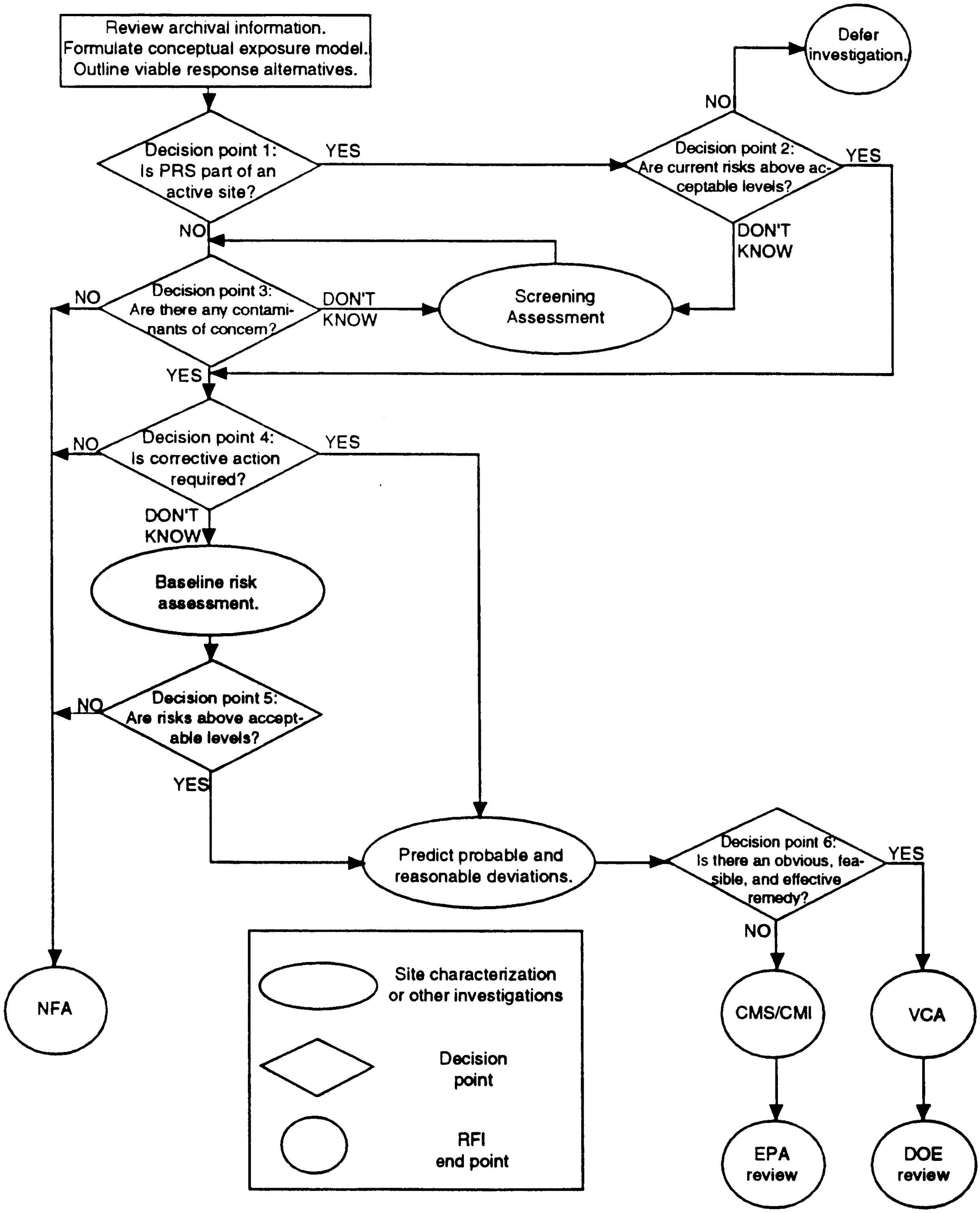


Figure 6.4-1 Technical Decision Process for OU 1098 (Terms are defined in Table 6.4-1).

TABLE 6.4-1

TERM DEFINITIONS

Archival Data. Archival data constitutes information collected to date from published and unpublished records pertaining to the history or processes of a SWMU. Records can include written communication such as reports, memoranda, letters, notes, or calculations. Verbal communication can be considered as archival data. Archival data is sometimes of unknown quality.

Contaminants of Concern (COCs). COCs are any compound or element present in environmental media or on structural debris at a concentration above its screening action level (SAL). COCs may consist of one or more RCRA- or CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act)-regulated constituents or of radioactive elements/daughter products.

Phase I. Phase I refers to the initial sampling phase of site assessment work, which usually is intended to collect adequate information to confirm the presence or absence of COCs in the environment. Phase I activities also can include restricted data collection that will further define the extent of contamination or site conditions relevant to the potential for waste migration, or serve as a basis for initial risk assessment. Information collected during Phase I sampling and analysis will determine whether more detailed Phase II sampling is necessary or if NFA is warranted for the SWMU under investigation.

Phase II. Phase II constitutes the second sampling phase of site assessment at PRSs at which constituents have been confirmed, and is based on archival or Phase I sampling investigations. Phase II sampling and analysis will help to determine the physical/chemical characteristics of the site and attempt to delineate the nature and extent of contamination. Phase II data will be used for contaminant fate and transport modeling, risk assessment, and design of treatability and corrective measure studies, as required.

6.4.2 Decision Point 2

Are the current risks (of PRSs associated with active sites) above acceptable levels?

If the answer is no, then further action on some PRSs could be deferred until the active site, building, or utility with which it is associated is decommissioned from use. Upon decommissioning, the RFI process will revert back to Decision Point 1. If during the active use of the site, building, or utility, evidence becomes available that this PRS is now a potential risk to receptors, action can no longer be deferred and the technical process for this PRS will revert back to Decision Point 2. If the current risks are known to be above acceptable levels, then corrective actions will be considered (Decision Point 4). If the current risks associated with active PRSs are unknown, a screening assessment may be indicated.

6.4.3 Decision Point 3

Are there any contaminants of concern?

Decision Point 3 is designed to identify those PRSs which do not have COCs and, according to criteria presented in Chapter 8, can be recommended for NFA. A screening assessment, as part of Phase I, will be undertaken if the presence or absence of constituents is not known.

The presence of COCs at a PRS is considered to be confirmed if any sample contains any constituent in a concentration that exceeds the SAL for that constituent when the appropriate analytical methods are used.

The absence of a constituent is confirmed if that constituent is not detected or if the concentration of the constituent does not exceed its background levels.

Regional background concentrations for some naturally occurring constituent are available, as noted in this chapter. Background data from Laboratory locations will be provided by the technical team for the ER Program's Framework Studies in time for analysis of Phase I data.

A "yes" answer at Decision Point 3 indicates that the presence of COCs at the PRS has been confirmed and that the PRS must then be evaluated at Decision Point 4. A "no" answer indicates that the absence of COCs at the PRS has been confirmed and that a recommendation of NFA (provided that ecological impact is not significant and that multiple constituents are not detected) may be justified.

The data required to make a decision at Decision Point 3 include the concentrations of suspected constituents at selected sample locations at each PRS. The purpose of the screening assessment in Phase I is to acquire the analytical and field data needed to make a defensible decision at Decision Point 3. Information on site history, physical site characteristics, and chemical and physical behavior of suspected contaminants will be considered during sampling activities. The data quality objectives process that addresses these data needs is discussed in Subsection 6.5.1.

6.4.4 Phase I Sampling Process

The phased approach to site characterization is consistent with EPA and the Laboratory's IWP guidelines. The technical approach generally requires a screening assessment aspect of Phase I field investigations to confirm the presence or absence of constituents above the most conservative SALs that are likely to be set at OU 1098. Phase I activities will consist of a screening assessment for most PRSs for which the potential for significant contamination exists. In these cases, the objective of Phase I sampling is not complete characterization of the site but, rather, confirmation of the absence or presence of COCs (Decision Point 3). The Phase I sampling design process attempts to model the "worst case" condition of the contaminant scenario so that Phase I sampling points can be chosen with the maximum chance of yielding confirmatory results. As analytical results become available, sampling and analysis plans (SAPs) will be revised as necessary based on these results. In this manner, an iterative process is established that retains flexibility as new data are obtained.

For those PRSs for which the presence of constituents is known (e.g., 2-005 and 2-009), the objectives of Phase I sampling will be:

1. To determine the extent of contamination (in support of possible VCA or eventual CMS),
2. To determine the average level of contamination (in support of risk assessment activities), and/or
3. For preliminary assessment of the potential for offsite migration (to assist in design of Phase II).

Where appropriate, the screening assessments for PRSs for which the presence of COCs is unknown will also be designed to assist in these three objectives. In addition, Phase I data will be used to identify accepted statistical concepts for evaluating sufficiency of sampling and additional data needs for modeling waste migration. The objectives for the Phase I sampling analysis plans for specific PRSs are contained in Chapter 7.

6.4.5 Decision Point 4

Is corrective action required?

Decision Point 4 is designed to identify those PRSs which may be recommended for NFA based on the criteria presented in Chapter 8 of this workplan and in the IWP. If the extent and concentrations of COCs are known, a corrective action (which is not necessarily based on risk assessment) may be recommended without the need for a Phase II investigation. Corrective action may also be indicated for those PRSs where several constituents are known and present an unacceptable cumulative risk, or where radionuclides are present and the principles of ALARA suggest the need for corrective action. Otherwise, PRSs will proceed to a Phase II investigation as necessary.

6.4.6 Phase II Sampling and Modeling Process

The purpose of Phase II sampling is to develop a more detailed picture of the nature and extent of contamination at PRSs, a picture which is sufficiently detailed for risk assessment and planning of the CMS (if required). The approach of Phase II SAPs will vary significantly for individual PRSs as a function of the amount and type of data available from previously obtained information, Phase I and Framework Studies efforts, and other considerations. Sources of potential variation in the environmental measurement process will be included in the design of Phase II SAPs.

Phase II will probably be an iterative process for TA-2 and TA-41 in which rapid turnaround data will be used to track the progress of the investigation against the data quality objectives (DQOs) for the phase. The Phase II investigation plan will be amended as data needs are refined by Phase I results and as approaches are selected for risk assessment, modeling, long-term institutional control, and other issues important to this OU.

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

6.4.7 Risk Assessment Process

Because ecological- and health-based risk assessments are integral to the Laboratory's RCRA process, risk assessment will be performed for all TA-2 and TA-41 PRSs, excluding those recommended for NFA, to determine if risks are above acceptable levels (Decision Point 5). The initial assessment consists of comparison of Phase I data with SALs to determine whether a Phase II investigation is necessary. This assessment will incorporate the total data set for each PRS as obtained through archival review and Phase I investigations. The initial assessment using SALs may also be used to determine whether the site should undergo a VCA or, at least, an interim action (IA). If an immediate action (VCA or IA) is not justified, then the baseline risk assessment will be performed after completion of Phase II investigations. Data quality objectives for Phase II investigations will incorporate any requirements not otherwise noted that are specific to data gathering for risk assessment. The risk assessment results will serve as input to Decision Point 5.

6.4.8 Decision Point 5

Are human-health or ecological risks above acceptable levels?

Decision Point 5 is the final step in the decision process at which a PRSs may be recommended for NFA. A recommendation for NFA at this point in the decision process is based on comparision of the calculated aggregate risk from all constituents (both human-health and ecological risk) with the acceptable levels of risk. If risk is known to be above acceptable levels, then a CMS or other appropriate remedial action is indicated. A CMS (or an alternative response action such as a VCA) may be required for PRSs at which one or more constituents are present at levels at which risk to human health or the environment is determined to be unacceptable. A remedial action also may be indicated based on the ALARA principle for PRSs containing radiological constituents. Decisions on remedial actions will require that probable conditions and reasonable deviations first be predicted.

6.4.9 Predict Probable Conditions and Reasonable Deviations Process

This process is designed to state the nature and extent of contamination in terms of potential short- and long-term risk to human and ecological receptors. Both the probable conditions as well as reasonable deviations must be known for proper design of a remedial action (Decision Point 6). This process will be based in part on the total set of validated data now available for each PRS and the associated risk assessment.

6.4.10 Decision Point 6

Is there an obvious, feasible, and effective remedy?

When an obvious and effective remedy exists, it may be proposed as a VCA without a formal CMS at several points: immediately after the evaluation of archival information, after a limited RFI Phase I investigation, or after completed Phase I and II investigations. VCAs tend to be removal and treatment options rather than *in situ* treatment or containment and, therefore, must meet restrictions on treatment and disposal of hazardous wastes and other restrictions that apply to alternative remedial actions of this type (LANL 1992, 0768). The effectiveness of the VCA will be confirmed through DOE review. If there are significant questions about the ability of a proposed VCA to meet these criteria or if no obvious and feasible remedy exists, then CMS and CMI are more appropriate than VCA. Data for each PRS collected during the RFI and the predicted probable conditions and reasonable deviations will be considered in the design of the CMS/CMI.

6.5 Data Quality Objectives Process

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

Because these decisions must be technically sound and validated to be defensible, an attempt has been made to collect as much reliable archival information about each site as possible. To ensure that data of appropriate and sufficient type, quantity, and quality are collected during Phase I sampling, we have applied the DQO process to the development of Phase I SAPs. These SAPs are presented in Chapter 7 of this OU work plan.

The DQO process is a seven-step process developed by the EPA for the planning of an effective and efficient data collection program (EPA 1987a, 0086). A well-planned data collection program will ensure that the right type, amount, and quality of data are collected on which defensible environmental decisions can be based. The level of uncertainty that is acceptable is also addressed in the DQO process.

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

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

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

1. ***Statement of the problem.*** The environmental conditions at TA-2 and TA-41 are addressed generally in Chapters 3, 4, and 5, and by specific PRS in Chapter 7. Assessment and remedial considerations are addressed in this chapter.
2. ***Identify decisions that address the problem.*** Potential land use and remedial actions are developed elsewhere in Chapters 4 (land use) and 6 (remediation).
3. ***Identify inputs affecting the decision.*** Decision inputs are addressed in Chapters 3 through 6.
4. ***Specify spatial and temporal domains of the decisions.*** Domains are addressed in Chapters 3 through 6.
5. ***Develop logic statements.*** PRS-specific logic statements (decision questions) pertaining to specific PRS characterization are developed in Chapter 7.
6. ***Establish constraints on uncertainty.*** Uncertainty issues are addressed generically in Chapter 6 and by specific PRS in Chapter 7.
7. ***Optimize design for obtaining data.*** The SAP for each PRS is addressed in Chapter 7.

This seven-step process was followed when DQOs were developed for this work plan. Decisions 1 and 2 require decision-maker confidence in archival data; decisions made from archival data of uncertain quality could be made without a formal set of DQOs. Acceptance of archival data at face value sometimes is justified for the purposes of RFI planning.

Decisions 3, 4, and 5 require data of known quality, both for determination of the nature and extent of contamination and for risk analysis. To ensure that the sampling and analytical efforts determine the nature and extent of contamination, an upper confidence bound at 95% (one-tailed) will be used. Phase I data used in making Decision 3 will include data of at least analytical Level III quality.

As previously stated, risk assessment data needs have yet to be fully defined. However, the assumption used is that approaches similar to those currently in use by EPA will be applied for human-health risk assessment. As required, DQOs for this OU will be reviewed and amended for consistency as better information becomes available.

For the purpose of setting DQOs, OU-wide objectives of this RFI are defined below.

- Identify contaminants at each PRS,
- Determine the nature, quantity, and extent of contamination for each PRS,
- Identify contaminant migration pathways from each PRS and from the OU as a whole,
- Characterize the TA-2 and TA-41 environment sufficiently to allow quantitative migration pathway and risk analyses, as necessary,
- Provide the data needed for initial assessment of remedial alternatives, and
- Provide the basis for planning the CMS.

6.5.1 Phase I Data Quality Objectives

Data quality objectives for Phase I SAPs have been developed through use of the seven-step process described in Section 6.5. The DQO process for Phase I SAPs is discussed in following sections and is outlined in a diagram in Figure 6.5-1.

6.5.1.1 Problem Statement

For some of the PRSs at OU 1098, the presence and possible locations of constituents is suspected but has not been confirmed. Environmental samples will be collected and analyzed to confirm the presence or absence and the location of constituents at these PRSs. For other PRSs, constituents are known to be present but their full extent and potential for migration are insufficiently known. Environmental data associated with these uncertainties must be collected before risk assessment can be performed.

Problem Statements:	Contaminants of concern (COCs) may be present at SWMUs within OU 1098. The full extent, average concentrations, and potential for migration of constituents are insufficiently known.
Questions to Be Answered:	Do the data collected in Phase I Sampling confirm the presence of constituents at this PRS? For those PRSs which are known to contain constituents, what is the average concentration and extent of these constituents? Is the migration potential of constituents adequately defined for Phase II design?
Data Needs:	• Field data (survey and screening results) • Analytical data (concentrations of constitutes) • Site processes • Potential release mechanisms • Site history • Potential contaminants • Site hydrogeology • Site geochemistry
Problem Domain:	Definition of the locations, concentrations, and types of constituents within each PRS.
Decision Rule/ Logic Statement:	If concentrations of all analyzed constituents are below SALs, and if no ecological impact is identified, then recommend for NFA. If corrective action is not indicated (see Decision Point 4), then proceed to Phase II.
Uncertainty Constraints:	Sampling plans will be designed to minimize the chances of obtaining false negative results.
Sampling and Analysis Plans:	See Chapter 7

Figure 6.5-1 Data quality objectives process for Phase I of the RFI for OU 1098.

6.5.1.2 Questions to Be Answered

One or more of the following questions will be addressed during Phase I investigations; the specific question(s) for each PRS are discussed in Chapter 7.

- Do Phase I data confirm the presence or absence of constituents at this PRS?
- Are Phase I data sufficient to recommend NFA?
- If constituents are known to be present at a PRS, what are the average concentrations and extent of these constituents?
- Is the migration potential of constituents adequately defined for Phase II design?

6.5.1.3 Decision Inputs

Two sets of decision inputs (data to be collected) are necessary to support the decisions made at Decision Point 3. These sets include the following:

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

The first set includes information that must be gathered before the sampling plan can be developed. The second set includes the concentrations of constituents at the site as determined by field and laboratory analyses of samples collected during Phase I investigations.

Specific data needs on an individual PRS basis are discussed in Chapter 7. Table 6.1-1 lists important constituents present at TA-2 and TA-41, and the appropriate analytical method and analytical detection limits for each constituent. This table is meant to be a bridge between the development of DQOs and the preparation of the SAPs.

6.5.1.4 Problem Domain

The problem domain for Phase I sampling includes determination of the locations, concentrations, and types of constituents within each PRS at OU 1098.

6.5.1.5 Decision Rule/Logic Statement

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

> A PRS will be identified as having COCs if data collected from a PRS during Phase I indicate that an SAL has been exceeded. If no COCs are identified, then that PRS will be considered for

NFA. If any single sample collected from the PRS during Phase I exceeds these guidelines after data validation, then the PRS will undergo further study.

The criteria for NFA presented in Chapter 8 will also be applied when determining if a PRS can be recommended for NFA. For several reasons, this decision will not necessarily be based on a statistical characterization of the contamination levels at a PRS. First, any type of averaging of sample results would remove maximum values and increase the chances of making a Type II error (i.e., a false negative or an incorrect conclusion that COCs are not present). Second, in most cases, the goal of Phase I is not a complete characterization but rather simply a determination as to whether constituents are present or absent. In addition, the locations of most PRSs are not in question.

6.5.1.6 Uncertainty Constraints

To fully validate and define a decision to recommend a PRS for NFA at Decision Points 3 and 4, we have designed Phase I SAPs so that the probability of a significant false negative result (Type II error) is very low. (False negative refers to concluding that a constituent is not present at a certain level when in fact it is present). This is done by focusing the sampling design toward those areas judged most likely to contain the highest concentrations of COCs and by including some low-cost redundancy in the field investigation (e.g., area radiological screening). No attempt is made in Phase I sampling design to limit the chances of false positive (Type I) errors, as these errors will be identified during Phase II sampling. Thus, the consequences of Type I errors are that some additional cost and time will be expended in Phase II. As stated in Subsection 6.5.1.5, statistical constraints regarding the treatment and comparison of Phase I data with background or action levels depend upon the method adopted for this RFI work plan. A comprehensive statistical effort is reserved for Phase II.

6.5.2 Phase II Data Quality Objectives

Data quality objectives for Phase II SAPs will be developed through use of the seven-step process described in Section 6.5. In general, Phase II activities will focus on determining the full extent and concentrations of constituents at OU 1098. Data collection also will be designed to support baseline risk assessment and related data needs such as the fate and transport of constituents.

6.6 Field and Analytical Data Quality Requirements

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

6.6.1 Analytical Data Quality Levels

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

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

Additional characteristics of the five categories are given in Table 6.6-1. In general, Levels I and II are associated with on-site portable field instrumentation or tests that can yield "real-time" survey or screening data. Levels III and IV are associated with strict field laboratory or off-site laboratory protocol, including radionuclide analyses and documentation that will generate high-quality, defensible data. Level V will accommodate all special analytical methods that are not covered under standard Level III or IV parameters. Quality of Level V work can meet either Level III or IV standards.

6.6.1.1 Phase I Analytical Levels

Investigations for this RFI will be performed under a combination of analytical data quality levels to meet the PRS-specific, contaminant-related field investigation requirements described in Chapter 7. Phase I investigations generally will be performed under analytical Levels I, II, and III. Levels I and II data will be collected as part of a field survey and screening program to allow for qualitative, real-time evaluations of site conditions. Level I field screening and survey will include a variety of portable field instrumentation or field test kits that can continually or periodically give information on site conditions. Level I observations also are used as a critical part of the site health and safety plan. Table 6.6-2 provides additional details. Level II activities will include the use of field survey methods and portable field laboratories (Table 6.6-3).

Level III analytical data will be obtained during Phase I through use of mobile field laboratories or off-site laboratories that can support RFI/CMS decisions for each PRS. Level IV data will be used as appropriate for confirmation of Level III or archival analytical data; collection of Level IV data is not planned in Phase I. Level V analyses can include measurements for nonconventional parameters, method modifications, analytic suites from 40 CFR 261 (Appendix VIII) or 40

TABLE 6.6-1
SUMMARY OF ANALYTICAL LEVELS APPROPRIATE TO DATA USES

Data Uses	Analytical[a] Level	Type of Analysis	Limitations	Data Quality
Site characterization; monitoring during implementation; identification of gross contamination	Level I	Radiological field screening and surveys	Response dependent on radiation type and conditions; response limited to upper 1–2 m of soil	Method-specific
Identification of gross contamination	Level I	HE spot tests	Matrix dependent	Qualitative
Site characterization; evaluation of alternatives; engineering design; monitoring during implementation	Level II	Variety of organics by GC, inorganics by AA, XRF, ICP	Tentative identification; analyte-specific	Dependent on QA/QC steps employed
		Radiologic field screening and surveys	Response dependent on radiation type	Qualitative or semi-quantitative depending on method
		Field laboratory analyses for some radiological constituents	Tentative identification and quantification	Dependent on QA/QC steps employed
Risk assessment; site characterization; evaluation of alternatives; engineering design; monitoring during implementation	Level III	Organics/inorganics, using EPA procedures other than CLP; analyte-specific	Specific identification; tentative identification in some cases; quantification.	Detection limits similar to CLP
		RCRA characteristic tests	Can provide data of same quality as Level IV; quantification	Less rigorous QA/QC than for Level IV
		Radiological constituent	Specific identification; detection limits below background; with suitable QC, gives quality comparable to SW 846 methods; quantification.	QA/QC comparable to SW 846 methods
Risk assessment; evaluation of alternatives; engineering design	Level IV	TCL/TAL organics/ inorganics by GC/MS, AA, ICP, etc.	Tentative identification of non-TCL parameters	Goal is data of known quality
		Low ppb detection limit	May require time to validate packages	Rigorous QA/QC
Risk assessment	Level V	Nonconventional methods	May require method development	Method-specific
			Mechanism to obtain services requires lead time	
			Method-specific detection limits	

[a] EPA (1987a, 0086)

ABBREVIATIONS:

AA = atomic absorption
CLP = Contract Laboratory Program
EPA = Environmental Protection Agency
GC = gas chromatography
ICP = inductively coupled plasma
MS = mass spectrometry
RCRA = Resource Conservation and Recovery Act
TAL = target analyte list
TCL = target compound list
XRF = X-ray fluorescence

TABLE 6.6-2

DATA TYPES, USES, AND QUALITY LEVELS FOR TA-2 AND TA-41 CHARACTERIZATION ACTIVITIES

Data Type (OU-wide subsurface Data Type	Intended Uses	Required Data Quality
Geomorphology (for example, geologic base map, drainage patterns, sediment deposition areas)	Identify surface geologic features that may influence contaminant movement, and distribution	Standard documented geological field methods will provide sufficient quality for the identified uses
	Determine if overland or channel flow patterns can result in off-site transport	Standard documented geological field methods will provide sufficient quality for the identified uses
Map of faults/fractures	Determine potential impact on site stability and contaminant transport pathways via faults and fractures	Standard documented geological field methods will provide sufficient quality for the identified uses
	Contamination is assessed based on comparison of SALs not background	Level III analytical laboratory analyses are required

TABLE 6.6-2 (Continued)
DATA TYPES, USES, AND QUALITY LEVELS FOR TA-2 AND TA-41 OU-WIDE CHARACTERIZATION ACTIVITIES

Data Type Subsurface Characterization	Intended Uses	Required Data QualityOU-Wide
Mineralogy/geochemistry (for example total organic carbon, mineralogical composition, distribution coefficient (k_d), etc.)	Predict sorptive capacity of environmental settings and possibly the chemical forms of constituents as input for contaminant migration models.	Standard operating procedures. The intended use is consistent with normal use of these data, thus standard methods provide appropriate data quality
Hydrogeological parameters (for example bulk density, porosity, permeability, hydraulic conductivity)	Estimate flux and velocity of contaminant movement in vadose zone; input to a flow and transport model	The required data uses can be supported by data provided by standard laboratory methods. Excessive variability in early data may require additional sampling/analysis to identify source of variability
Pore fluid composition (for example isotope characterization of water extracted from bulk tuff)	Delineate depth of migration of water that has infiltrated the subsurface; determine absolute ages of pore water in vertical hydrostratigraphic sections.	Standard field and laboratory methods. These were developed for the intended data uses provided data of sufficient quality.

TABLE 6.6-3

DATA TYPES, USES, AND QUALITY LEVELS FOR SWMU-SPECIFIC CHARACTERIZATION ACTIVITIES

Data Type	Intended Uses	Required Data Quality
Field surveys (e.g., area radiological surveys and geophysical surveys)	Direct reading/recording instruments to scan land surface and measure *in-situ* conditions.	Level I and II data are acceptable
Field screening (e.g., gross alpha, area radiological, and, lithological logging)	Point of collection sample measurements; identification of grossly contaminated samples; documentation of sample lithology; support of Health and Safety operations.	Level I and II data are acceptable
Field laboratory measurement (e.g., gross alpha, gross beta, gamma spectrometry)	Guidance for field operations (borehole stopping criteria, health and safety, sample transportation, etc.); aid in selecting judgmental sampling locations (e.g., identifying areas of anomalous radioactivity for sampling); reduction of analytical sample load.	Level II data will be used since confirmatory analytical laboratory measurements will be obtained. Some techniques may be Level I or Level III, as well.
Analytical laboratory measurements (e.g., SW846, radiochemistry)	High-quality, defensible data; accurate, precise quantification of a broad list of analytes; risk assessment.	Level III data are required. In some circumstances, well supported Level II data may be acceptable.

CFR 264 (Appendix IX), physical testing of soils or rock, or other nonstandard methods that may be employed in this RFI.

6.6.1.2 Phase II Analytical Levels

Phase II analytical levels will be similar to those used in Phase I (Levels I, II, and III).

6.6.2 Analytical Methods and PARCC Parameters

Analytical methods selected for analyses of soil, water, or air samples collected during this RFI will follow standard laboratory protocol recognized by the EPA (see Tables 6.6-4 and 6.6-5) or their equivalent. The analytical methods include a variety of techniques that apply to over 300 individual analytes. EPA's "Test Methods for Evaluating Solid Waste," SW 846 protocol (EPA 1987b, 0292), will be used to test for volatile and semivolatile organic compounds, and metals. Analyses for radionuclides and miscellaneous analytes will be performed under other acceptable analytical methods; representative methods for radionuclides and miscellaneous analytes are listed in Table 6.6-5, although additional methods may be identified prior to actual analysis of samples. Table 5.2 of the OU 1098 QAPjP (Annex II) identifies alternate analytical methods and data quality levels for COCs that have background or screening action levels below standard minimum detection limits (MDLs) or practical quantification limits (PQLs). At present, the IWP guidance is to use available analytical methods with detection limits lower than health-risk based SALs (Section 4.4.2 of the IWP). Table 6.6-5 summarizes the analytical methods that may be used during this RFI.

Tables V.3 through V.12, IX.1, and IX.2 in the Laboratory's generic Quality Assurance Project Plan (QAPjP) contain additional information concerning analytical methods for constituents of interest at this OU and Los Alamos Canyon. The QAPjP uses the specific methods to list the individual constituents analyzed under each method, the corresponding chemical abstract service numbers, and the PQLs or MDLs for each constituent.

The PARCC parameters are analytical and sampling quality assurance criteria that have been established to ensure that quality is maintained during field sampling and sample analytical activities. A thorough discussion of the PARCC parameters for the Laboratory's ER Program is presented in Section 5.0 of the generic QAPjP.

6.6.3 Sample Collection Quality Requirements

Numerous field activities can have an impact on the overall data quality for the ER Program. Such activities include equipment calibration schedules and procedures, sample method selection and technique, sample containers, preservatives, sample holding times, the number or type of quality control samples, sample documentation, and equipment decontamination. To ensure that data quality is maintained in the field, we discuss specific details for each of

TABLE 6.6-4

REPRESENTATIVE INSTRUMENTATION AND METHODS FOR PROPOSED ANALYTICAL LEVELS

LEVEL I: FIELD SCREENING

• Portable Instruments

- FIDLER
- Geiger-Mueller counter
- Micro-R meter
- Organic vapor analyzer (OVA)
- Photoionization detector (PID)
- Explosimeter
- Oxygen level indicator
- pH, temperature, conductivity meter
- X-ray fluorescence analyzer

• Field Test Methods/Kits

- OVA headspace test
- HNU headspace test
- Handby kit
- Draeger tubes
- Hazcat kits
- Lab in a Bag®
- Chloride test kits (soil)
- Hach Kits™
- High explosives

LEVEL II: FIELD SURVEYS/INSTRUMENTATION

• Mobile analytical lab
• Surface geophysics
• Borehole geophysics
• Soil vapor surveys (portable instruments)
• Radiological screening laboratory
• Vehicle-based or hand-operated gamma spectrometry system

LEVEL III: LABORATORY METHODS/INSTRUMENTATION

• SW 846 protocol for soil, air, and water analysis for VOCs and SVOCs, organic chlorine pesticides and PCBs, and metals found on Los Alamos off-site or field laboratories

• Laboratory, DOE, US Army, or EPA analytical methods for radionuclides, or miscellaneous analyses; see LANL-ER-QAPjP

• Instrumentation typically includes GC, GC/MS, inductively coupled argon plasma spectroscopy (ICAP), inductively coupled plasma atomic emission spectroscopy (ICPAES)

LEVEL V: LABORATORY METHODS

- American Society for Testing and Materials (ASTM) protocol for soil/rock testing
- Method-specific protocol for contaminated and non-contaminated soil/rock

TABLE 6.6-5

SUMMARY OF ANALYTICAL METHODS
FOR THE ANALYSIS OF SAMPLES COLLECTED AT OU 1098

EPA Methods	**Contaminants**
• EPA SW-846 Method 8080	Organochlorine Pesticides
• EPA SW-846 Method 8240*	VOCs
• EPA SW-846 Method 8270*	SVOCs
• EPA SW-846 Method 6010*	Inorganics
Radionuclides - LANL or DOE Methods*	**Contaminants**
• Gas flow proportional counting	Gross alpha, gross beta
• Alpha spectrometry	Isotopic plutonium
• Gamma spectrometry	Cesium-137, technetium-99, cobalt-60
• ICP	Total Uranium
• Liquid scintillometry	Tritium
Other Methods	
• Miscellaneous analytes*	
• Physical testing of soil or rock (ASTM protocol)	

*Alternate analytical methods are listed in the QAPjP (Annex II) of this IWP for analytes with screening action levels lower than conventional method's (8240, 8270, 6010) MDLs or PQLs.

these activities in Annex II of this OU work plan (QA Project Plan), in the generic QA/QC (quality control) plan for the Laboratory's ER Program, and in the Laboratory's Standard Operating Procedures (SOPs) Manual for the ER Program. Table 6.6-6 contains guidelines for sampling frequency for QA/QC control samples of various types.

TABLE 6.6-6

GUIDELINES FOR MINIMUM QA/QC SAMPLES FOR FIELD SAMPLING PROGRAM

QC Sample Type	Applicable Sample Matrix	Applicable QA/QC Sample Matrix	Sample Frequency (1 per each analytical batch or)
Field Duplicate	Soil	Soil	1 per 20 samples
	Water	Water	1 per 10 samples
Rinsate Blank	Soil	Water	1 per 20 samples
	Water	Water	1 per 10 samples
Trip Blank*	Water	Water	1 per shipping cooler
Field Blank**	Water	Water	1 per shipping cooler
		Water	1 per shipping cooler

*Trip blank collected only for samples requiring VOC analysis.
**Field blanks collected only for samples requiring non-radiological analyses.

CHAPTER 6 REFERENCES

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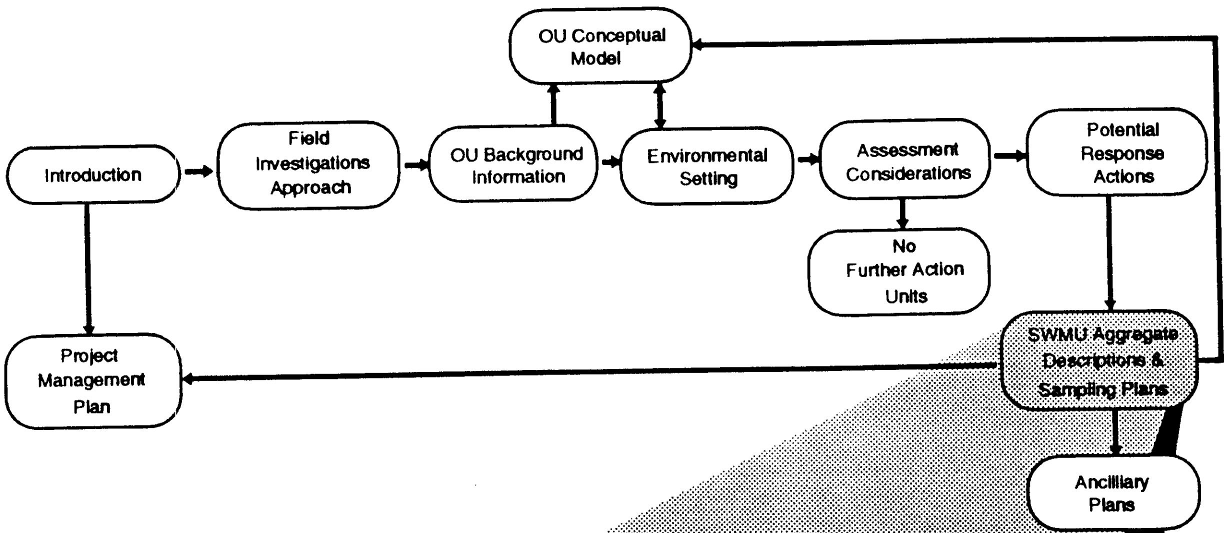
Chapter 7



SMWU Descriptions & Sampling Plans

- Baseline
- TA-2
- TA-41

7.0 EVALUATION OF SOLID WASTE MANAGEMENT UNITS AT TA-2 AND TA-41

For Operable Unit (OU) 1098, data are needed primarily to define the distribution and extent of contaminants in surface and near-surface soils, sediments, Bandelier Tuff, surface water, and groundwater. Contamination above screening action levels may be present at Technical Area (TA)-2 and TA-41. The principal potential contaminant-migration pathways are through soil and sediment erosion, surface water and groundwater movement, and from airborne particle transport. Transport of significant levels of contaminants is considered important for the following reasons:

- TA-2 and TA-41 are located within Los Alamos Canyon where run-off is significant,
- The depth to the uppermost alluvial aquifer is less than 10 ft, and a perched aquifer may exist at greater depths (250-300 ft) within the basalt-Puye Formation,
- The Otowi Member is characterized by near-saturated flow conditions within canyon bottoms, with relatively high porosity and permeability as compared with the Tshirege Member,
- The distance to potential downgradient receptors and wetland inhabitants is short for the assumed exposure scenarios where groundwater pathways are known, and
- Unknown quantities of contaminants are anticipated at TA-2 and TA-41.

For these reasons, the likelihood that public health or environment may be impacted by contaminants from TA-2 and TA-41 will be evaluated during Phase I and Phase II investigations.

Phase I activities for OU 1098 will include two types of investigations. The first is a baseline characterization for the area of Los Alamos Canyon encompassing TA-2 and TA-41. The second type of investigation is PRS-specific, in which the presence or absence of potential contaminants is ascertained, and in some cases the extent and average level of contamination is estimated. The number and type of samples/screening for the total of Phase I activities is summarized in Table 7.0-1.

Baseline characterization and PRS-specific sampling activities to be conducted at OU 1098 during Phase I investigation include the following:

TABLE 7.0-1
SUMMARY OF THE SCOPE OF THE OU 1098 RFI

Phase I Investigations

	Number of Discrete Samples							
Chapter/ Section	**Surface Soil/Sediment Samples**	**Sump, Dry Well, Catch Basin, Septic**	**Subsurface Core Samples[e]**	**Surface Water Samples[b]**	**Ground-water Samples[b]**	**Number of QA/QC Samples[c]**	**Number of Boreholes Drilled (Borehole Length in ft)**	**Radiological Screening Area (ft^2)**
7.2 Baseline	82[a]	---	--- ---	20	24	20[d] 3	5 (15) Shallow 1 (250–300) Intermediate	(f)
7.4 SWMU 2-003	18	---	6	---	---	3	2 (15)	5300
7.5 SWMU 2-004	6	---	24	---	---	3	8 (15)	112,000
7.6 SWMU 2-005	12	---	0	---	---	3	0	0
7.7 SWMU 2-006	2	4	6	---	---	6	2 (15)	500
7.8 SWMU 2-007	2	---	3	---	---	3	1 (15)	1750
7.9 SWMU 2-008	3	---	9	---	--	3	3 (15)	7400
7.10 SWMU 2-009	25	---	36	---	---	9	12 (15)	5250
7.11 SWMU 2-010	0	---	0	---	---	0	0	0
7.12 SWMU 2-011	4	8	12	---	---	6	4 (15)	1200
7.13 SWMU 2-012	0	---	6	---	---	3	2 (15)	0
7.14 SWMU 41-001	0	---	6	---	---	3	2 (15)	2200
7.15 SWMU 41-002	13	---	15	---	---	9	5 (15)	14,100
7.16 SWMU 41-003	6	---	0	---	---	3	0	3300
7.17 AOC C 41-004	1	14	3	---	---	6	1 (15)	250
TOTAL	174	26	126	20	24	111	48	153,250

[a]Number of baseline surface soil/sediment samples. The 22 surface samples plus fifteen sediment transect samples which will be taken quarterly for one year for a total of 60 transect samples.

[b]Surface water samples will be taken from five locations in the creek, quarterly for one year, for a total of 20 samples. Groundwater samples will be taken from six locations, quarterly for one year, for a total of 24 samples.

[c]Column list includes only QA/QC samples for soil/sediment and core samples. Total includes an additional 32 QA/QC smaples needed for surface and groundwater samples.

[d]Number of baseline characterization QA/QC surface soil/sediment samples includes 4 QA/QC samples to be collected each quarterly sediment transect sample collection, for a total of 16 QA/QCA samples over one year.

[e]Values in this column assume three subsurface core samples per 15 ft borehole at PRSs. The number of core samples per baseline characterization borehole is variable.

[f]A[illegible] to be determined. See Section 7.2.4.1 for details.

1. Perform surface tritium vapor flux measurements and conduct radiological surveys at TA-2 and TA-41 to aid in locating areas of anomalous radiation in the subsurface and surface, respectively.
2. Sample surface soils and sediments within 50 ft of known/suspected PRSs, as described in Sections 7.4 through 7.17 of this work plan, to determine the absence or presence of potential contaminants. The 50 ft distance is judged to be sufficient to ensure that the PRS is inside the area sampled.
3. Drill and collect core materials from characterization boreholes in the alluvium at the most suspect PRS locations/spill sites, as described in Sections 7.4 through 7.17 of this work plan.
4. Install and sample six new characterization borehole wells in the alluvium (five) and perched basalt-Puye Formation (one) within OU 1098 to further define the presence or absence of contaminants of concern (see Figure 7.2-1).
5. Sample stream water and sediment within OU 1098 with emphasis on evaluating contaminant inventory.
6. Identify the locations of springs and gaining/losing stream reaches within OU 1098. Stations that measure surface water flow will be located upstream and downstream of the known zones of fracturing/faulting within OU 1098 and at locations where stream sediment is sampled.

Data quality needs, data quality objectives, and the investigation rationale for Phase I activities for OU 1098 are presented in Section 7.1. Section 7.2 addresses baseline characterization activities that will be conducted outside of the formal PRS boundaries, but primarily within TA-2 and TA-41. Section 7.3 presents an overview of the field investigation methods that will be used for Phase I activities at OU 1098.

Individual sampling plans for the following PRSs, located at TA-2, are addressed in Sections 7.4 through 7.13:

- Section 7.4 SWMU 2-003, Decommissioned Reactor Waste Unit
- Section 7.5 SWMU 2-004, Storage Pits and Tanks of the Omega West Reactor
- Section 7.6 SWMU 2-005, Cooling Tower Drift Loss
- Section 7.7 SWMU 2-006, Drains
- Section 7.8 SWMU 2-007, Decommissioned Septic System
- Section 7.9 SWMU 2-008, Outfalls

- Section 7.10 SWMU 2-009, Operational Releases
- Section 7.11 SWMU 2-010, Chemical Shack Waste Units
- Section 7.12 SWMU 2-011, Storm Drains and Outfalls
- Section 7.13 SWMU 2-012, Potential Soil Contamination Under Former Tanks

The following PRSs, located at TA-41, are addressed in Sections 7.14 through 7.17

- Section 7.14 SWMU 41-001, Septic System
- Section 7.15 SWMU 41-002, Sewage Treatment Plant
- Section 7.16 SWMU 41-003, Sump
- Section 7.17 AOC C-41-004, Storm drains

The objectives of the field investigation, a list of the potential contaminants of concern, and the detailed sampling strategy for each PRS are described in these sections.

7.1 DATA NEEDS AND INVESTIGATION RATIONALE FOR OU 1098

This section describes the data needed to address the primary objectives of Phase I and Phase II investigations, and the overall rationale for the investigation strategies for the Phase I activities described in sections 7.4 through 7.17. By identifying the objectives of each Phase of investigation and by considering site-process knowledge in the investigation rationale, the strategy for the RFI process becomes more focused and efficient.

7.1.1 RFI Data Needs

The three key field objectives for Phase I investigations at OU 1098 are to collect data to:

1. Confirm the absence or presence of constituents at PRSs where the potential contamination is unknown;
2. Define the extent and average concentration of constituents, primarily on areas where the presence of contamination is known, and
3. Help assess the potential for migration of constituents.

Results from Phase I investigations will also be used to design Phase II. Phase II investigations will be designed to provide data for baseline risk assessment including collecting more extensive data for objectives 2 and 3 of Phase I. Data from Phase I and Phase II investigations will be used to determine the distribution and level of contamination in the surface and subsurface of OU 1098. The specific data needs for Phase II will be identified during Phase I investigation.

A combination of geophysical survey, surface-area (OU wide) radiological screening, and Level III analysis of discrete surface and subsurface samples is proposed to address the first and second objectives. Detailed characterization of soil and borehole characteristics is used to address the third objective.

The following activities will be performed to collect data needed to address the objectives of Phase I of the RFI for OU 1098.

- Survey surface soils at the 22 discrete sample locations indicated in Figure 7.1-1; at other locations outside of PRSs, but within OU 1098, for radiological screening; and at the selected locations around several of the PRSs as indicated in Sections 7.4 through 7.17, to detect areas of anomalous radioactivity (defined as 2 sigma above the mean radiation level of the area). This survey will be supplemented by Level III analyses for specific radionuclides and RCRA metals as outlined in the SAPs. Selected samples will be analyzed for Appendix IX analytes in addition to the indicator analyte list.

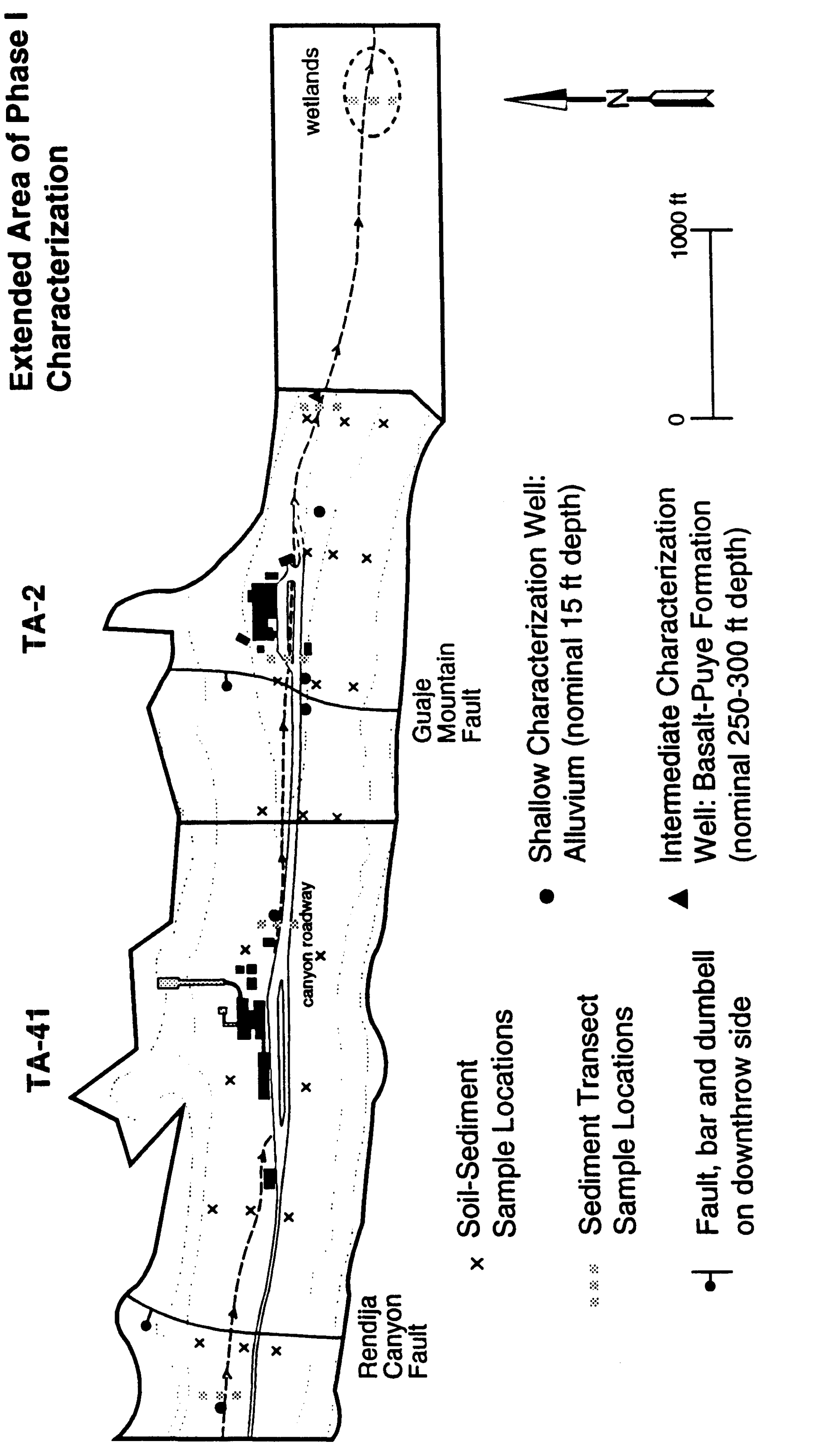


Figure 7.1-1 Baseline Characterization sampling locations at TA-2 and TA-41.

- Collect and analyze core samples for the analytes listed in each SAP from a network of shallow boreholes (15 ft or greater, as appropriate) at OU 1098.
- Determine hydrogeochemical properties pertinent to risk assessment and contaminant transport for selected surface water, groundwater, soil, sediment, and near-surface tuff samples collected within OU 1098 and collect geotechnical data pertinent to risk assessment and contaminant transport at OU 1098.

7.1.2 Investigation Rationale

Past activities at TA-2 and TA-41 indicate that an appropriate set of analytes is required if areas of contamination are to be defined through direct surface and subsurface sampling. It is further anticipated that because of soil texture and erosional processes and the nature of releases, surface contamination may be highly discontinuous. The sampling analyses plans presented in this chapter are based on our knowledge of site processes derived from archival research.

For most PRSs (e.g., where the presence of COCs is unknown), locations of sampling points are chosen based on the likelihood of higher concentrations of constituents. For example, drains and outfalls (SWMU no. 2-008) are to be sampled near the point of discharge to increase the likelihood of detection. Similarly, sediment samples are to be collected at the first downstream fine-grained sediment depositional area identified in Los Alamos Canyon, to detect contamination that may have migrated outside the OU. In addition, to increase the likelihood of detecting contamination, sampling point locations may be moved based on site conditions, for example, identification of physical disturbance of the PRS, or detection of anomalous radioactivity by field screening instruments.

For select PRSs, sampling points are included to determine the extent of and possible migration of constituents. For example, some sample points for SWMU no. 2-009 are designed to be downgradient of the known Cs-137 soil contamination based on reports of the location of residual Cs-137 and flow directions of the alluvial aquifer in which the contaminated soil resides.

The locations of all sampling points in the industrial areas of TA-2 and TA-41 (i.e. in the vicinity of structures) are shown in Figures 7.1-2 and 7.1-3, respectively.

Baseline characterization is required to establish OU-specific baseline conditions relative to PRSs, because of liquid discharges of tritium and cesium-137 and atmospheric dispersal of chromium and tritium. The indicator contaminants for the baseline characterization and PRS-specific SAPs were also selected based on site-process knowledge. For TA-2, these indicator contaminants include:

- tritium,
- cesium-137,

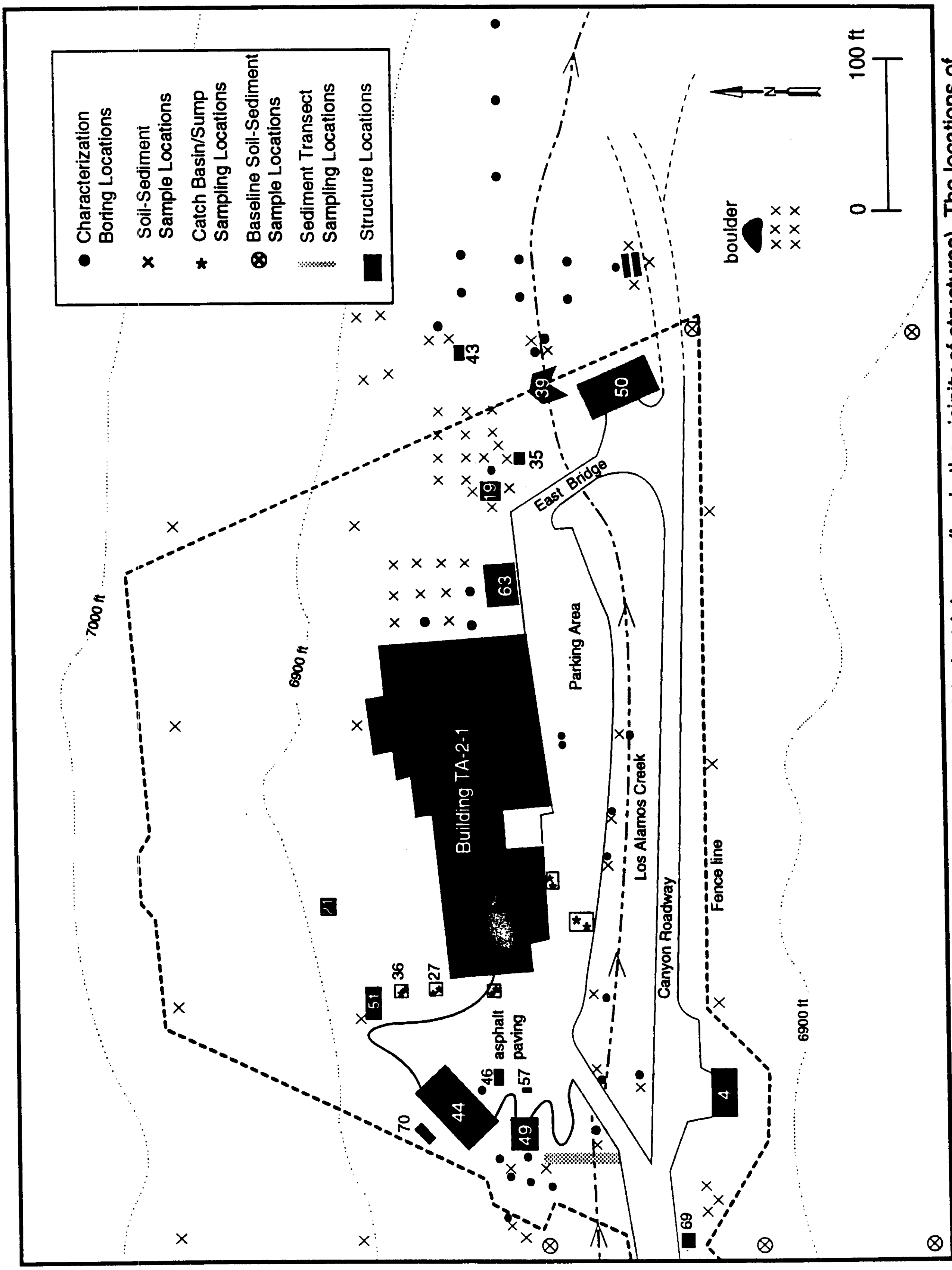


Figure 7.1-2 Locations of sampling points in the TA-2 industrial area (i.e. in the vicinity of structures). The locations of sampling points relative to specific PRSs are shown in figures in sections 7.4-7.13.

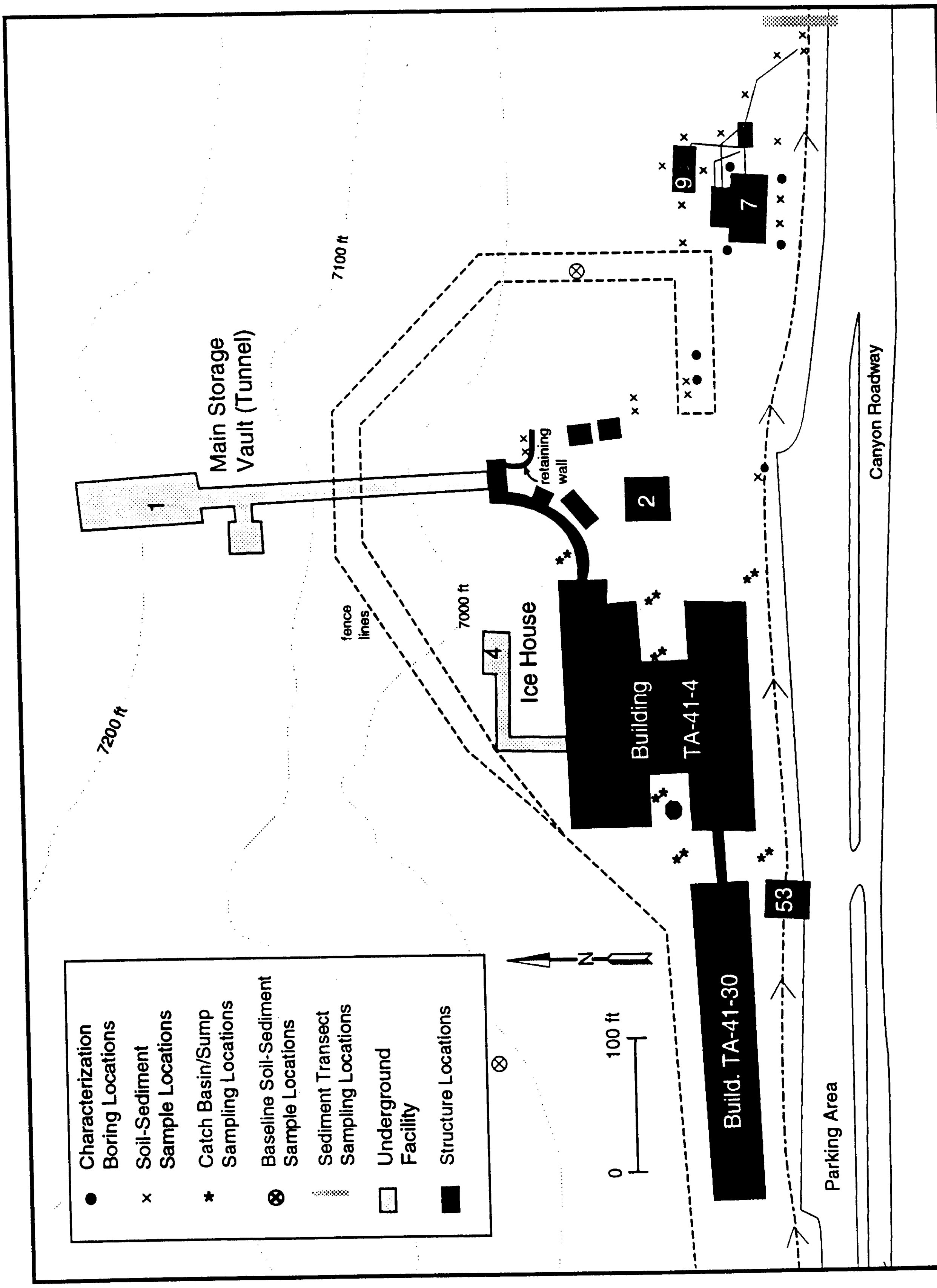


Figure 7.1-3 Locations of sampling points in the TA-41 industrial area (i.e. in the vicinity of structures). The locations of sampling points relative to specific PRSs are shown in figures in sections 7.14-7.17.

- gross alpha, beta, and gamma radioactivity
- strontium-90,
- technetium-99,
- total uranium,
- isotopic plutonium,
- cobalt-60,
- chromium, (hexavalent and total)
- and mercury.

Indicator contaminants from TA-41 include:

- gross alpha, beta, and gamma radioactivity
- tritium,
- beryllium,
- total uranium,
- isotopic plutonium,
- mercury, and
- lead.

Additionally, approximately 20% of baseline characterization samples will be analyzed for Appendix IX semivolatiles, volatiles, inorganics, and organochlorine pesticides to assess the presence or absence of other contaminants not expected for TA-2 and TA-41. Constituents detected in these samples may be added to SAPs as appropriate. For PRS-specific investigations, all samples collected will be analyzed, at a minimum, for the baseline potential COCs for the technical area in which the PRS is located.

7.2 BASELINE CHARACTERIZATION DURING PHASE I ACTIVITIES

7.2.1 Introduction

To properly assess the potential for contaminant movement within the hydrogeological and geochemical systems of TA-2 and TA-41, a sufficient technical understanding of the environmental setting (see Chapter 4) is required. The available data discussed in Chapters 4 and 5 of this work plan suggest that, in general, infiltration through the unsaturated zone is a pathway of concern for OU 1098. Unsaturated- and saturated-zone characterization also is important because soil excavation and long-term monitoring are likely remedial alternatives for TA-2 and TA-41. Hydrogeological characterization is an important investigative focus of this RFI because of the potential inventory of tritium, fission products and other radiological constituents, and hazardous wastes buried at TA-2 and TA-41, the extremely long period of time over which they will remain hazardous, the existence of the Rendija Canyon and Guaje Mountain faults, and the relative lack of subsurface characterization data that would permit detection of potential contaminant movement.

Required baseline geological, geochemical, and hydrological studies of TA-2 and TA-41 include surface and subsurface characterization. During Phase I activities at OU 1098, samples for baseline characterization will be collected from soils, sediments, tuff, basalt, surface water, and groundwater within the floodplain to the base of the canyon walls. Baseline data provide a basis against which PRS constituent levels can be compared. Baseline data may also be used in an initial assessment of risk, and to help evaluate remedial alternatives for TA-2 and TA-41 that are based in part on the influence of natural geologic barriers and pathways of contaminant movement.

7.2.2 Site Hydrogeologic Regulatory Requirements

Section P of the Laboratory's Resource Conservation and Recovery Act (RCRA) Part B Permit (EPA 1990, 0306) requires comprehensive characterization of hydrogeological and geochemical properties relevant to contaminant migration in soils and sediments above the regional aquifer (Santa Fe Group). Baseline characterization of TA-2 and TA-41 is specified to include, but not be limited to, the following hydrogeological and geochemical information:

- Facility-specific geological/hydrogeological characteristics affecting groundwater flow and quality beneath the facilities,
- Topographic features that might influence the groundwater flow system,
- Representative, accurate classification and descriptions of near-surface hydrogeological units that may be part of the migration pathways at the facility (that is, the aquifers and any intervening saturated and unsaturated units),

- Zones of near-surface fracturing or channeling in consolidated or unconsolidated deposits, and zones of high or low permeability that might direct and restrict the flow of contaminants,
- Representative description of water level or fluid pressure monitoring, and
- Man made influences that may affect the hydrogeology of the site.

7.2.3 Background/Rationale for Baseline Characterization and Potential Contaminants

Surface studies are an important component of this RFI because surface water, groundwater recharge, and airborne processes can potentially expose and transport contaminants to receptors. Phase I baseline characterization activities for OU 1098 will focus on supporting PRS-specific activities by:

- Providing indicator analyte, site-wide baseline levels against which possible TA-2 and TA-41 and other source-term PRS releases can be compared,
- Assessing migration potential of contaminants from TA-2 and TA-41 release sites,
- Allowing the significance and potential of future surface contaminant transport to be evaluated more accurately,
- Determining the lateral and vertical variability in physicochemical properties related to surface and subsurface transport,
- Delineating surface-water flow paths,
- Providing surface data to supplement subsurface structural information obtained from characterization wells and boreholes.
- Identifying potential contaminants not identified by archival research of individual PRSs, and
- Identifying areas of contamination outside the boundaries of the PRSs (possibly arising from contaminant migration) which may serve as potential secondary sources of contamination.

Indicator contaminants for baseline characterization of OU 1098 include constituents which are likely to have been released in TA-2 and TA-41 operations as summarized in Section 7.1 of this work plan. All samples collected for baseline characterization will be analyzed for all indicator contaminants on the TA-2 and TA-41 lists. Additionally, 20% of all baseline characterization samples will be analyzed for Appendix IX constituents to assess the presence or absence of other COCs not expected in TA-2 or TA-41 operations. Table 7.2-1 summarizes the potential COCs for baseline characterization.

7.2.4 Baseline Characterization Plan

Baseline characterization activities of OU 1098 during Phase I will include sampling of surface soil and sediment, installation of six characterization boreholes to assess hydrologic characteristics, collection of surface water and groundwater samples, and radiological (walkover) survey of the industrial areas of TA-2 and TA-41 which are not addresed in the PRS-specific plans. These activities will be performed following LANL Standard Operating Procedures, as listed in Table 7.3-1. The total number of samples to be collected for baseline characterization of OU 1098 is summarized in Table 7.2-2.

TABLE 7.2-1
POTENTIAL CONTAMINANTS OF CONCERN
BASELINE CHARACTERIZATION FOR TA-2 AND TA-41

Potential Contaminant of Concern	Level III Method
Gross alpha/beta	Gas flow proportional counter
Cesium-137	Gamma spectrometry
Strontium-90	Gas flow proportional counter
Technetium-99	Gamma spectrometry
Uranium (total)	ICP (EPA method 6010)
Plutonium (isotopic)	Radiochemical separation and alpha spectrometry
Cobalt-60	Gamma Spectrometry
Tritium	Distillation and liquid scintillation
Mercury (soil/sediment)	EPA Method 7470, Cold Vapor
Mercury (water)	EPA Method 245.1, Manual Cold Vapor Technique
Inorganics* (including lead chromium, and beryllium)	EPA Method 6010, ICP
Semivolatile organics*	EPA Method 8270
Volatile organics*	EPA Method 8240
Organochlorine pesticides*	EPA Method 8080
Gross gamma	Gamma spectrometry

**20 percent of surface soil/sediment and transect samples will be analyzed for Appendix IX inorganics, semivolatile organics, volatile organics, and organochlorine pesticides.*

TABLE 7.2-2
SUMMARY OF SAMPLES FOR OU 1098
BASELINE CHARACTERIZATION FOR TA-2 AND TA-41

	Number of Samples				
	Surface Soil	**Sediment Transects***	**Subsurface Soils**	**Surface Water*****	**Ground Water******
Analytical samples	22	15	2	5	6
QA samples					
Rinsate blank	1	1	1	1	1
Field duplicate	1	1	1	1	1
Field blank**	1	1	1	1	1
Trip blank******	1	1	1	1	1
Total number of samples	26	19	6	9	10

* Five sediment transects will be sampled at OU 1098, collecting three sediment samples per transect, for a total of 15 sediment transect samples. These creek sediment samples will be collected quarterly for one year for a total of 60 samples. The purpose of quarterly creek samples is to establish contaminant distributions associated with sediment cycling along Los Alamos Creek within OU 1098.

** Field blanks will be submitted for non-radiological analyses only

*** Surface water to be collected from five locations in the creek quarterly for one year for a total of 20 surface water samples. One of each type of QA sample will be taken at each quarter.

**** Groundwater samples to be collected from the six characterization boreholes (five shallow alluvial and one intermediate) quarterly for one year for a total of 24 groundwater samples. One of each type of QA sample will be taken at each quarter.

***** Trip blanks will be taken only for those sample locations requiring VOA analysis.

7.2.4.1 Radiological Survey

A radiation survey wil be conducted in the industrial areas of TA-2 and TA-41 (i.e., in immediate vicinity of structures and outfalls of each TA) not addressed by PRS-specific plans, in order to identify potential radiological anomalies associated with activities at TA-2 and TA-41. A walkover survey of these areas will be performed. The locations of radiation anomalies above two standard deviations from the mean radiation level detected in these areas, and the corresponding activities, will be recorded on the field log. If point sources are indentified on a case-by-case basis during these surveys, voluntary corrective actions (VCAs) to remove point sources and subsequent surface sampling may be implemented, after permitted ER disposal facilities are available.

7.2.4.2 Surface Soil and Sediment Sampling

Sampling of surface soil and sediment will be done in two stages. First, 22 surface soil samples will be collected at intervals of 500 ft to optimize sampling locations from a cost-efficient perspective (Figure 7.1-1). Sample depths will vary according to the thickness of soil and alluvium. Surface sampling will generally be at an interval of 0 to 12 in., depending on soil and alluvium thickness, without using a drill auger. This depth is preferred over sampling at an interval of 0 to 6 in., particularly along stream banks and in the floodplain, because there is a greater probability of detecting chemical substances deposited by water during the earlier years during which TA-2 and TA-41 were in operation. Note that surface soil sampling to greater depths may be performed at a few selected locations. The sampling below 12 in. will be useful in further delineating areas of historical deposition. These locations will supplement the annual sampling done by the Environmental Surveillance Group (ESG) of the 11 established surface stations in Los Alamos Canyon and will augment surface sampling at individual PRSs, as described later in this chapter.

The second stage of soil and sediment sampling for baseline characterization of OU 1098 will be five transects across Los Alamos Creek to assess constituent concentrations and distribution in creek sediments. The locations of these transects are shown in Figure 7.1-1. One transect will be located at the western boundary of the OU, one immediately downstream of the sewage treatment plant at TA-41, one immediately upstream of TA-2, one at the eastern boundary of OU 1098, and one at the first major fine-grain depositional area downstream of TA-2. Each transect will consist of three surface soil/sediment samples taken at a depth of 0 to 12 in. The sampling locations of these three surface samples will be taken from the active stream bed and both sides of the stream channel. Transect samples will be collected quarterly for one year, at the time that surface and groundwater samples are collected (Sections 7.2.4.3 and 7.2.4.4).

7.2.4.3 Characterization Borehole Installation and Sampling

Six characterization boreholes will be completed at OU 1098 to assess baseline hydrologic characteristics. Five shallow characterization boreholes will be completed into the alluvium at OU 1098, and one intermediate characterization borehole will be completed to a possible perched water zone in the Basalt-Puye Formation (250-300 ft). The locations of these boreholes are shown on Figure

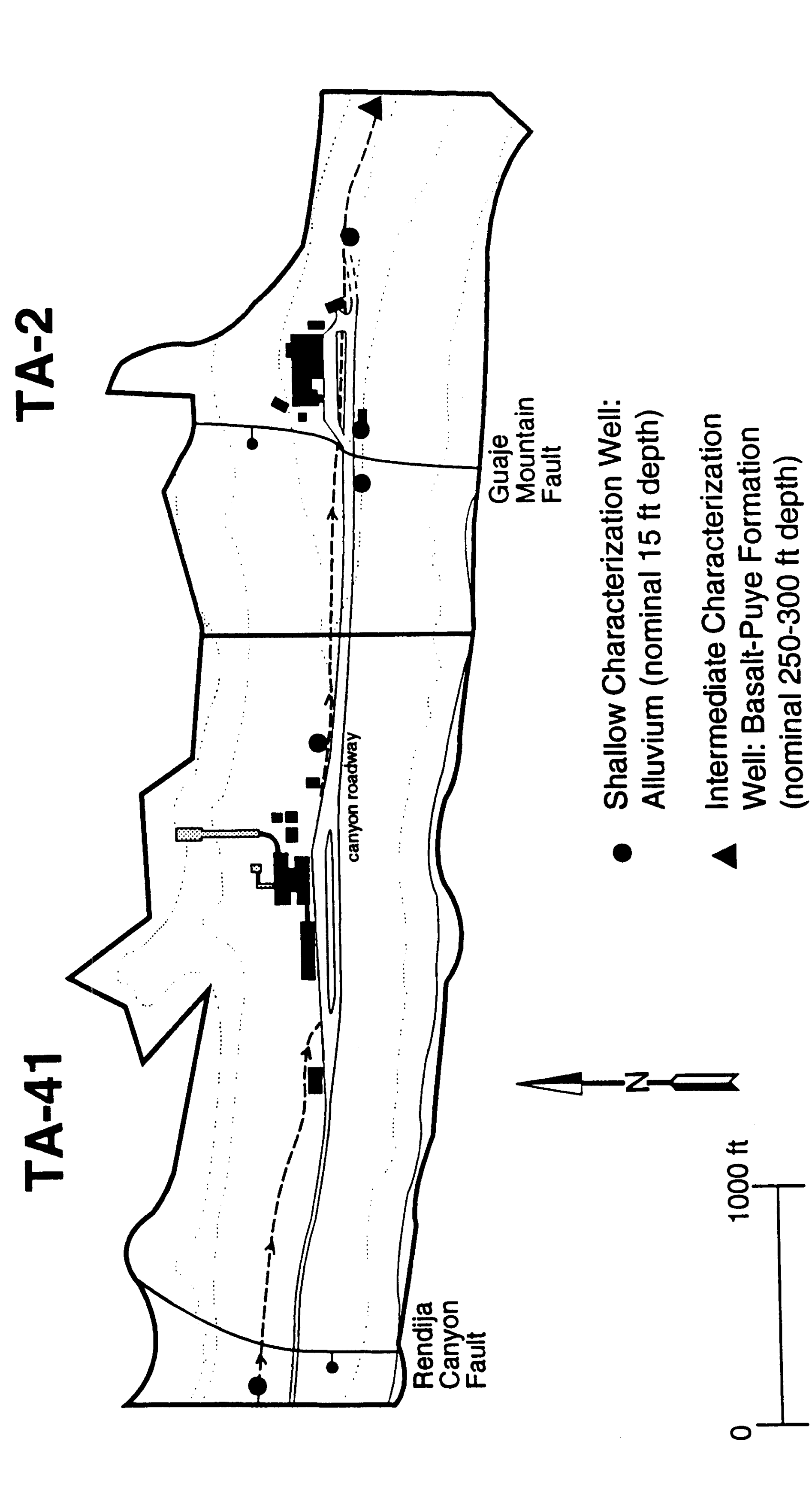


Figure 7.2-1 Location of proposed baseline characterization wells to be completed into alluvium and basalt-Puye Formation.

7.2-1. One shallow borehole will be installed at the western boundary of OU 1098 to assess the quality of incoming groundwater. The next shallow (<50 ft) borehole will be installed below the sewage treatment plant at TA-41 to evaluate the impact of the plant on alluvial groundwater quality. Two additional shallow boreholes will be installed on either side of the Guaje Mountain fault zone west of the main buildings of TA-2 to assess the effect on water flow through the fault zone. The last shallow borehole will be placed east of the main buildings at TA-2, on the south side of the stream, to evaluate groundwater quality downstream of the main TA-2 operations.

The intermediate characterization borehole will be placed at the eastern boundary of TA-2. This borehole will be used to identify the existence of a possible perched water zone in the Basalt-Puye Formation and to evaluate the water quality of this water zone if it exists. During Phase II activities, if additional boreholes are completed in the Basalt-Puye Formation, the effect of the Guaje Mountain fault zone on the anticipated perched water zone will be evaluated using these boreholes by observing differences in water level elevations and in groundwater quality within corresponding hydrologic units.

The shallow boreholes (except those on either side of the Guaje Mountain Fault) will be completed as alluvial wells with 2-in diameter PVC, or suitable equivalent, well screen expected to be approximately 5 to 10 ft in length. The shallow boreholes on either side of the Guaje Mountain Fault will be completed with 4-in diameter stainless steel casing. These boreholes will be completed in accordance with applicable guidance from the EPA Technical Enforcement Guidance Document (EPA 1985) and LANL SOPs listed on Table 7.3-1.

The intermediate borehole will be drilled to the Basalt-Puye Formation and completed either as a characterization well (if water is present) or for vadose zone characterization. The anticipated hole total depth is not expected to exceed a nominal 300 ft below land surface. The borehole will be completed with a minimum 4-in. diameter surface completion. The characterization well will be constructed with a surface casing extending below the surface alluvial aquifer and grouted in place prior to advancing the borehole to the planned hole total depth. The borehole completion will be dependent upon the hydrogeologic conditions encountered at the Basalt-Puye Formation. In the event perched water is found, the borehole will be completed with a stainless steel screen, or equivalent, 5 to 10 ft in length and stainless steel casing to the boundary of the perched zone. From the perched zone boundary to the surface, an alternate casing, such as standard steel or PVC may be used, with a dielectric, to minimize cost. A permanent ground water pump suitable for the collection of defensible groundwater data may be installed. In the event that perched water is not encountered, the borehole may be instrumented with a porous cup vacuum lysimeter or alternative vadose zone monitoring instrument. The borehole will be completed in accordance with the applicable guidance in the EPA Technical Enforcement Guidance Document (EPA 1985) and applicable LANL SOPs listed in Table 7.3-1. If water is encountered below the alluvial aquifer but at a depth more shallow than the Basalt-Puye Formation, completion of the borehole to the Baslt-Puye Formation will be reassessed.

Core material from all characterization boreholes will be field screened for radioactivity. If sections of core are found to have anomalous radioactivity, samples will be collected and analyzed for the baseline potential contaminants outlined in Section 7.2.3. At least four samples will be collected for analysis between the alluvium and Basalt - Puye formation, with sampling biased towards the shallower depths. Additionally, at least one sample will be collected from the intermediate characterization borehole from the Basalt-Puye Formation and analyzed for baseline potential contaminants.

7.2.4.4 Groundwater Sampling

Groundwater from the shallow boreholes will be sampled on a quarterly basis for the first year to determine if the groundwater quality is affected by seasonal variation. Water samples will be collected in accordance with LANL SOPs listed in Table 7.3-1, and will be analyzed for the list of constituents provided on Table 7.2-1. The need for additional quarterly sampling will be evaluated on the basis of the first four quarters of sampling. In the event the first four quarters do not indicate that seasonal changes affect the groundwater chemistry, sampling may be curtailed to once every six months in coordination with the needs of the environmental surveillance group (ESG) of the laboratory. Alternatively, significant fluctuations in the observed groundwater chemistry may necessitate continued quarterly sampling for environmental restoration requirements in preparation for further characterization activities.

Groundwater will also be collected from the intermediate borehole and will be analyzed for the constituents shown on Table 7.2-1 on a quarterly basis or as water is available for collection. Data from this borehole will not provide PRS-specific information, but will indicate whether additional characterization of the perched zone is necessary at OU 1098.

Samples collected from all boreholes will undergo field analytical measurements of temperature, specific conductance, pH, alkalinity, turbidity, and dissolved oxygen, as described in LANL-ER-SOP-06.02. Groundwater samples will also be analyzed for major anions (chloride, sulfate, phosphate, and fluoride) as determined by ion chromatography, and major cations (calcium, magnesium, potassium, and sodium) determined by ICP-MS, minor trace elements determined by CP-MS, and environmental isotopes including hydrogen/deuterium and oxygen-16/oxygen-18 (see Appendix C, Section C.3 for a complete listing of isotopes). These isotopic analyses are required to determine the recharge flux and source(s) of groundwater, for example tritium-contaminated alluvial groundwater, within the potential Basalt-Puye Formation groundwater.

7.2.4.5 Surface Water Sampling

Surface water samples from Los Alamos Creek will be collected at the five locations of the stream sediment transects. Water samples will be collected quarterly for one year, and will be analyzed for the constituents shown on Table 7.2-1. Additionally, surface water samples will be analyzed for major anions (chloride, sulfate, phosphate, and fluoride) as determined by ion chromatography, and cations (calcium, magnesium, potassium, and sodium) determined by ICP-MS, and will also undergo field analytical measurements of temperature, specific conductance, pH, alkalinity, and dissolved oxygen.

TABLE 7.2-3
SUMMARY OF ANALYSES FOR OU 1098
BASELINE CHARACTERIZATION

Level III Method	Number of analyses				
	Surface Soil	Sediment Transects*	Subsurface Soils	Surface Water*	Ground-water**
Gas flow proportional counter	24	17	4	7	6
Gamma spectrometry	24	17	4	7	6
Radiochemical separation and alpha spectrometry (plutonium)	24	17	4	7	6
Distillation and liquid scintillation	24	17	4	7	6
EPA Method 6010,	25	18	5	8	6
EPA Method 245.1, Manual Cold Vapor Technique	--	--	--	8	6
EPA Method 8270***	4	3	1	1	1
EPA Method 8240****	5	4	2	2	2
EPA Method 8080***	4	3	1	1	1

* Samples at sediment transects and surface water to be collected from five locations in the creek quarterly for one year. Totals in these columns should be multiplied by four to account for the number of analyses to be done for one year.

** Groundwater will be collected from six characterization boreholes (five boreholes completed in alluvium, one borehole completed in Basalt-Puye Formation) quarterly for one year. Totals in this column should be multiplied by four to account for the number of analyses to be done for one year.

*** 20 percent of all samples will be collected for Appendix IX analysis (includes semivolatile organics and organochlorine pesticides).

**** 20 percent of all samples will be collected for Appendix IX analysis of volatile organics. One extra sample is counted to include the trip blank required for sample locations with volatile organic analysis.

7.2.4.6 Sample Screening and Analysis

All sample packages will be screened for radiation using an alpha scintillometer, micro R meter, and pancake GM counter, prior to shipment to the laboratory for analysis.Table 7.2-3 summarizes the number of samples to be analyzed for each specified method of analysis in Table 7.2-1 for baseline characterization samples. Present screening action levels, practical quantitation limits, analytical methods, and required sample size for each analyte are presented in Table 5.1 in the Quality Assurance Project Plan for OU 1098 (Annex II).

7.2.5 Additional Phase I Baseline Characterization Activities

7.2.5.1 Geotechnical Analysis of Soils and Sediments

Soil and sediment samples identified during baseline characterization which are representative of different soil types within Los Alamos Canyon will be analyzed for geotechnical properties. These data will be collected in support of a baseline risk assessment. Geotechnical properties to be analyzed are:

- ASTM soil classification,
- mineralogical composition,
- bulk density,
- porosity (total and effective),
- total organic carbon,
- permeability or hydraulic conductivity, and
- K_d (distribution coefficient).

7.2.5.2 Geologic Base Map

Releases of tritium resulted from a leak in the primary cooling water system at OWR. The leak occurred from a break in a weld seam in a section of the delay line running from TA-2-1 to the surge tank. This release was discovered in January 1993 and was within the Guaje Mountain fault zone. Tritium was leaking from the delay line at a rate of up to 70 gallons per day until March 1993 when the cooling water was drained from this line. Typical concentrations of tritium in the cooling water ranged from 15.7 X10^6 to 20.2 X 10^6 pCi/L.

Although Vaniman and Wohletz prepared a general geologic map in 1990 that included TA-2 and TA-41 and other areas of Los Alamos Canyon (see Figure 4.5-2) as discussed in Chapter 4, more detailed fracture-density mapping is required to characterize the Rendija Canyon and Guaje Mountain faults in sufficient detail for the purpose of the TA-2 and TA-41 RFI. Additional data are necessary to evaluate hydraulic properties relevant to modeling the movement of groundwater at OU 1098 (due to this documented tritium release). By incorporating new data from the TA-2 and TA-41 RFI, as well as other information which was not available in 1990, an updated hydrogeological map of TA-2 and TA-41 will be produced.

Surface geological field work will be carried out at the TA-2 and TA-41 OU and outcroppings to supplement data obtained from boreholes. The geological map will be updated from Vaniman and Wohletz (1990, 0541) as additional information is accumulated during the RFI and will summarize existing baseline geological information to support subsequent site characterization that may be required. The geological map will show the distribution of TA-2 and TA-41 rock units and surficial materials as well as the orientation and dip of contacts, bedding planes, foliations, faults, and other discontinuities. The geological map also will show the lateral extent and thicknesses of rock units and major subunits, including their relative offsets, orientations, and fracture density. In addition, the TA-2 and TA-41 soil maps shown in Figure 4.3-1 will be updated as additional information is obtained during the RFI.

7.2.5.3 Geomorphic Characterization

Geomorphic characterization of Los Alamos Canyon will identify significant erosional processes that may compromise the stability of TA-2 and TA-41 PRSs over varied time scales. This characterization will generate a 1:3600-scale map (based on aerial photographs) emphasizing erosion and deposition areas relevant to TA-2 and TA-41. This map will include landforms and drainage patterns, sites of active and potential erosion, and potential infiltration areas. Soil series, colluvium and artificial fill, and the degree of soil profile development will be identified.

7.3 FIELD INVESTIGATION METHODS

7.3.1 Field Surveys

Phase I PRS investigations will begin with an engineering survey and environmental survey (radiological, metal detector, and/or inorganic and organic) to characterize each site before samples are collected. Specific methods for conducting these surveys are discussed further in Appendix C (Field and Laboratory Investigation Methods) of this work plan, and in specific LANL Standard Operating Procedures (SOPs) listed in Table 7.3-1.

7.3.1.1 Engineering Survey

Each PRS will be surveyed according to procedures documented by Los Alamos National Laboratory Facilities Engineering. The survey will locate facilities and components associated with the PRS and surface features. Additional features, grids, or locations will be staked according to sampling plans discussed later in this chapter. The grids will be used to locate radiation surveys (walkovers) and, in some cases, to select sample locations. Results of the engineering survey will be recorded on the site base map, and all located points and survey lines will be recorded by the New Mexico State Plane (NMSP) coordinate system. This survey data will be incorporated into the Facility for Information Management Analysis and Display (FIMAD) data base.

7.3.1.2 Environmental Survey

An environmental survey for radioactivity will be conducted at each PRS. At specific PRSs, surveys for organics may also be conducted. The grid pattern established during the engineering surveys will be followed during the walkovers so that observations can be referred back to base maps of the site. This grid-pattern search will ensure effective coverage of the areas having the maximum likelihood of elevated surface and subsurface contamination levels.

A preliminary radiological survey will be conducted at each site and in the industrial areas of TA-2 and TA-41 prior to sampling activities. This survey will be done using a variety of instruments, including an alpha scintillometer, micro R meter, field instrument for detection of low-level radiation (FIDLER), 2 x 2 NaI detector, and pancake Geiger-Müller (GM) counter. Additional metal detector surveys and surveys for semivolatile organic compounds (SVOCs) and volatile organic compounds (VOCs) will be conducted as described in the individual sampling plans. Any positive results or observations will be recorded on the base map of the PRS. In addition to characterizing the PRSs, these surveys will ensure the health and safety of personnel working at the sites.

The environmental survey will be used to select locations for biased sampling, the purpose of which is to maximize the chances of detecting contaminants at the site. The results of the environmental survey will be used as a preliminary

TABLE 7.3-1
SAMPLING METHODS
PHASE I ACTIVITIES - OU 1098

ACTIVITY	TECHNIQUE	LANL SOP
Surface soil/sediment sampling (including transect sampling)	General Sampling Instructions[a]	LANL-ER-SOP-01.01-06
	Field Health and Safety[b]	LANL-ER-SOP-02.01-11
	Field Surveying of Sample Locations	TBD
	Hand-held Instruments for Field Screening of Radioactive Substances	TBD
	Hand-held Instruments for Field Screening of VOCs	TBD
	Spade and Scoop Method for Collection of Soil Samples	LANL-ER-SOP-06.09
	Stainless Steel Surface Soil Sampler	LANL-ER-SOP-06.11
	Hand Auger and Thin-Wall Tube Sampler	LANL-ER-SOP-06.10
	Sediment Material Collection	LANL-ER-SOP-06.14
	Curatorial Sample Management[c]	LANL-ER-SOP-12.01-05
Borehole installation and subsurface soil sampling (sludge drying bed)	General Sampling Instructions[a]	LANL-ER-SOP-01.01-06
	Field Health and Safety[b]	LANL-ER-SOP-02-01.11
	Field Surveying of Sample Locations	TBD
	Hand-held Instruments for Field Screening of Radioactive Substances	TBD
	Hand-held Instruments for Field Screening of VOCs	TBD
	Drilling Methods and Drill Site Management	LANL-ER-SOP-04.01
	General Borehole Logging	LANL-ER-SOP-04.04
	Soil and Rock Borehole Logging and Sampling	LANL-ER-SOP-06.12
	Hand Auger and Thin-Wall Tube Sampler	LANL-ER-SOP-06.10
	Field Logging, Handling, and Documenting of Borehole Materials	LANL-ER-SOP-12.01
	Spill Control During Drilling	TBD
	Curatorial Sample Management[c]	LANL-ER-SOP-12.01-05
Sludge/sediment sampling sumps, catch basins, or dry wells	General Sampling Instructions[a]	LANL-ER-SOP-01.01-06
	Field Health and Safety[b]	LANL-ER-SOP-02.01-11
	General Surface Geophysics	LANL-ER-SOP-03.02
	Sediment Material Collection	LANL-ER-SOP-06.14
	Coliwasa Sampler for Liquids and Slurries	LANL-ER-SOP-06.15
	Trier Sampler for Sludges and Moist Powders or Granules	LANL-ER-SOP-06.17

TABLE 7.3-1 (Continued)

ACTIVITY	TECHNIQUE	LANL SOP
	Collection of Sand, Packed Powder, or Granule Samples Using the Hand Auger	LANL-ER-SOP-06.18
	Weighted Bottle Sampler for Liquids and Slurries in Tanks	LANL-ER-SOP-06.19
	Field Logging, Handling, and Documenting of Borehole Materials	LANL-ER-SOP-12.01
	Curatorial Sample Management[c]	LANL-ER-SOP-12.01-05
Surface water sampling	General Sampling Instructions[a]	LANL-ER-SOP-01.01-06
	Field Health and Safety[b]	LANL-ER-SOP-02.01-11
	Surface Water Sampling	LANL-ER-SOP-06.13
	Collection and Analysis of Water Samples for Tritium	LANL-ER-SOP-06.XX[d]
	Curatorial Sample Management[c]	LANL-ER-SOP-12.01-05
Groundwater sampling	General Sampling Instructions[a]	LANL-ER-SOP-01.01-06
	Field Health and Safety[b]	LANL-ER-SOP-02.01-11
	Fluid Level Measurement	LANL-ER-SOP-07.02
	Purging of Wells for Representative Sampling of Groundwater	LANL-ER-SOP-06.01
	Field Analytical Measurements of Groundwater Samples	LANL-ER-SOP-06.02
	Sampling for Volatile Organics	LANL-ER-SOP-06.03
	Soil Water Samples	LANL-ER-SOP-06.05
	Collection and Analysis of Water Samples for Tritium	LANL-ER-SOP-06.XX[d]
	Curatorial Sample Management[c]	LANL-ER-SOP-12.01-05
Monitor well installation and development	Field Health and Safety[b]	LANL-ER-SOP-02.01-11
	Monitor Well Construction	LANL-ER-SOP-05.01
	Well Development	LANL-ER-SOP-05.02

a General Sampling Instructions include seven SOPs:
- SOP-01.01 General Instructions for Field Investigations
- SOP-01.02 Sample Containers and Preservation
- SOP-01.03 Handling, Packaging, and Shipping of Samples
- SOP-01.04 Sample Control and Field Documentation
- SOP-01.05 Field Quality Control Samples
- SOP-01.06 Management of RFI-Generated Waste
- SOP-01.XX Data Validation Procedures (procedure number not yet assinged)

TABLE 7.3-1 (Continued)

[b] Health and Safety in the Field Instructions include eleven SOPs:
(Procedures are in preparation and will be finalized prior to initiation of Phase I drilling and sampling activity)
- SOP-02.01 Personal Protective Equipment
- SOP-02.02 Respirators
- SOP-02.03 Pre-Entry Briefings for Site Personnel
- SOP-02.04 Pre-Entry Briefings for Visitors
- SOP-02.05 Safety Meetings and Inspections
- SOP-02.06 Heat and Cold Stress and Natural Hazards
- SOP-02.07 General Equipment Decontamination
- SOP-02.08 Personnel Decontamination
- SOP-02.09 Accident/Incident Reporting
- SOP-02.10 Radiation Protection
- SOP-02.11 Training and Medical Surveillance

[c] Curatorial Sample Management Instructions Include five SOPs:
(Procedures are in preparation and will be finalized prior to initiation of Phase I drilling and sampling activity)
- SOP-12.01 Field Logging, Handling, and Documenting Borehole Samples
- SOP-12.02 Transport and Receipt of Borehole Samples by the Curatorial Management Facility
- SOP-12.03 Physical Processing and Storage of Borehole Samples at the Curatorial Management Facility
- SOP-12.04 Examination of Samples at the Curatorial Management Facility
- SOP-12.05 Acceptance of Non-Borehole Samples by the Curatorial Management Facility

[d] LANL-ER-SOP-06.XX - Collection and Analysis of Water Samples for Tritium - Procedure is in the review process and a SOP number has not yet been assigned.

TBD - Procedure to be developed.

assessment for areas in which contaminants are not expected. Negative environmental results do not constitute conclusive evidence of the absence of contaminants; however, positive results obtained at the beginning of PRS characterization will allow for convenient redirecting of the investigation plans.

7.3.2 Field Screening

All collected surface and subsurface samples will be field screened for gross alpha, beta, and gamma radioactivity. Samples may also be screened for organics if required in PRS-specific sampling plans. Field screening differs from field surveys in that field surveys cover the entire PRS area, whereas field screening is done at the point of sample collection. Lithologic logging of core samples is also only done at the point of sample collection.

7.3.3 Field Laboratory Measurements

Samples from areas identified as radiological anomalies (as defined in section 6.1.4) will be collected for mobile field lab measurement of gross alpha, beta, and gamma radiation. This measurement will provide a quantitative check on field survey and screening measurements.

7.3.4 Sampling Methods

Types of samples to be collected for Phase I PRS investigations include surface soil/sediment samples, subsurface samples, sediment transects, and surface and groundwater samples. Methods for collecting these samples are listed in Table 7.3-1, and are briefly described in Appendix C of this work plan. Detailed instructions for sampling are described in the specific LANL SOPs referenced in Table 7.3-1.

7.3.5 Drilling and Sampling Strategy for Field Operations

Personnel who are conducting subsurface investigations will utilize drilling techniques that are dependent upon the type and quantity of sample material required, the planned borehole total depth (TD), the constituents of interest, type of contamination controls, and rigor associated with maintenance of the sample integrity. In general, two primary forms of drilling are routinely utilized at the Laboratory: hollow stem augers with 5-ft-long split barrel samplers to depths of a nominal 250 ft below ground surface (BGS) and rotary systems to depths greater than 250 ft. The following discussion identifies key components associated with the selection of the appropriate drilling and sampling strategy to be incorporated into the decision process for this RFI Work Plan.

Hollow-Stem Auger Systems. Hollow-stem augers with 5-ft-long split-barrel samplers are used routinely for drilling and sampling (coring) to depths of up to 250 ft below ground surface (BGS) in volcanic tuff. Hollow stem augers with split barrel samplers can be used to obtain HX- or CP-size (variable diameter) core material for radiochemical and/or chemical analysis. Fluid circulation is not required to drill and sample with a hollow stem auger, a significant advantage over conventional rotary applications. In some cases, deionized water may be introduced directly to the borehole with a decontaminated stainless-steel dart bailer system. The prime disadvantages to the system are its depth limitation (may be less than 300 ft if basalts are encountered), rate of penetration, and disturbance to core material associated with the sampling process, and generation of relatively large volumes of "cutting" materials that may include contaminants at some sites.

Quality assurance (QA) procedures will be implemented and are critical to the implementation of this sampling strategy. This type of equipment is expected to be used for shallow drilling and sampling.

Rotary Drilling Systems. Drilling and sampling operations to depths greater than 250 ft (in volcanic tuff) will generally utilize a rotary drilling strategy. Rotary systems with wireline coring systems, capable of providing HX- or CP-size cores may be employed. In general, the core barrel will be lined to facilitate sample handling and containment at the surface. Several forms of rotary wireline systems may be used and will include, but are not limited to, a punch core, modified pitcher barrel, and conventional rotary wireline system. Fluids to be circulated in the rotary systems may include, but are not limited to, air, water, and inert gases (e.g., argon). Sidewall cross-contamination will be minimized by utilizing conventional circulation (through the bit). In general, circulation fluids will rely upon air filtered through a high-efficiency particulate air (HEPA) system or upon an air mist using deionized water. The inert gas may be introduced to those environments where the redox potential is a significant concern. The process by which the appropriate circulation fluid is selected will be based on the target analytes, target sample depth, and site-specific borehole conditions. Steps to avoid the introduction of muds, special polymers, and other proprietary constituents will be minimized and will be utilized only after field personnel have determined that the hole cannot be advanced without the special additives.

Rotary systems facilitate drilling and sampling to greater depth and completion of larger diameter boreholes than those systems typically associated with hollow stem auger equipment. In general, rotary applications have a greater rate of penetration than that of hollow stem auger tooling and can be used to collect core from hard rock systems. The primary disadvantages of rotary systems are the need to circulate a fluid in the borehole and potential impacts associated with the circulation of the fluid.

Borehole particulate and gaseous tracers will be utilized, as appropriate, to assist with the process of determining sample integrity and overall adequacy of the sampling program. Drilling and sampling procedures will be implemented and documented for all field operations.

Alternative Drilling Systems. In some cases, specialty drilling systems may be considered. Alternative systems that may be considered include, but are not limited to, sonic drilling, horizontal drilling, and dual-wall reverse air systems. These systems will be considered for applications that are difficult to accommodate with the systems discussed above. The sonic system will be considered in those environments that require minimal to negligible generation of dust and cuttings at the land surface. The horizontal systems will be utilized to access areas beneath existing structures, and the dual-wall reverse air systems will be employed when circulation loss is a problem in the borehole. In general, these systems are not well developed for coring applications, but the applicable technology is evolving rapidly.

7.4 SWMU NO. 2-003, DESCRIPTION OF DECOMMISSIONED REACTOR WASTE UNITS

7.4.1 Site Description and History

There have been three types of nuclear reactors located in building TA-2-1 since its establishment in 1944. The first reactor was the "Water Boiler," which was in operation from 1944 to 1974. SWMU 2-003 investigations address potential contamination associated with Water Boiler operation, as described further in this section. The second reactor was known as Clementine and was in operation from 1946 until its decommissioning in 1953. There are no known SWMUs directly associated with this reactor. The third reactor is the Omega West Reactor (OWR), which has operated from 1956 to the present. SWMU 2-004 investigations address potential contamination associated with OWR, and is described in section 7.5 of this work plan.

The Water Boiler reactor, a liquid-uranyl compound fueled reactor, was in operation from 1944 to 1974, and was decommissioned and decontaminated in 1986-87. Primary reactor water from the reactor contained a uranyl nitrate solution which underwent fission processes, resulting in a wide variety of fission products including cesium-137, strontium-90, and technetium-99. Secondary reactor cooling water, which contained small amounts of fission products, was routinely discharged to Los Alamos Creek. In 1964, a water hold-up tank [SWMU 2-003(e)] and alarm was installed to collect secondary cooling water in the event a break occurred in the reactor cooling coils with subsequent infiltration of primary reactor solution into secondary cooling water. Prior to 1964, if such a break occurred, primary cooling water containing uranium and fission products would have been discharged into Los Alamos Creek with the secondary cooling water.

Off-gases from the Water Boiler, which contained low levels of gaseous fission products including cesium-137, strontium-90, technicium-99, and iodine-131 were routed through an underground gaseous effluent line to the mesa top south of the reactor, where they were discharged through a stack. The following units were associated with the Water Boiler for off-gas handling:

1. The stack gas valve house (TA-2-19) [2-003(a)] and a 4-in. cast-iron pipe, through which three smaller lines passed from TA-2-1 to TA-2-19 (line 117), were decommissioned in 1986. Line 117 was part of the filtered gaseous effluent line that ran from the Water Boiler to the stack on top of the mesa south of TA-2. The stack gas valve house was a heavy, reinforced concrete structure mostly above ground, with dimensions of 11 ft by 9 ft by 10 ft high, and 18-in.-thick walls. Its purpose was to provide valves, pumps, and a shielded tank where condensate from the gaseous effluent line could be collected and handled (Figure 7.4-1). When they were removed, line 117 and building TA-2-19 showed a contact reading of 35 mR/h, but the soil beneath them was reported to be clean (Elder and Knoell 1986, 14-0014).

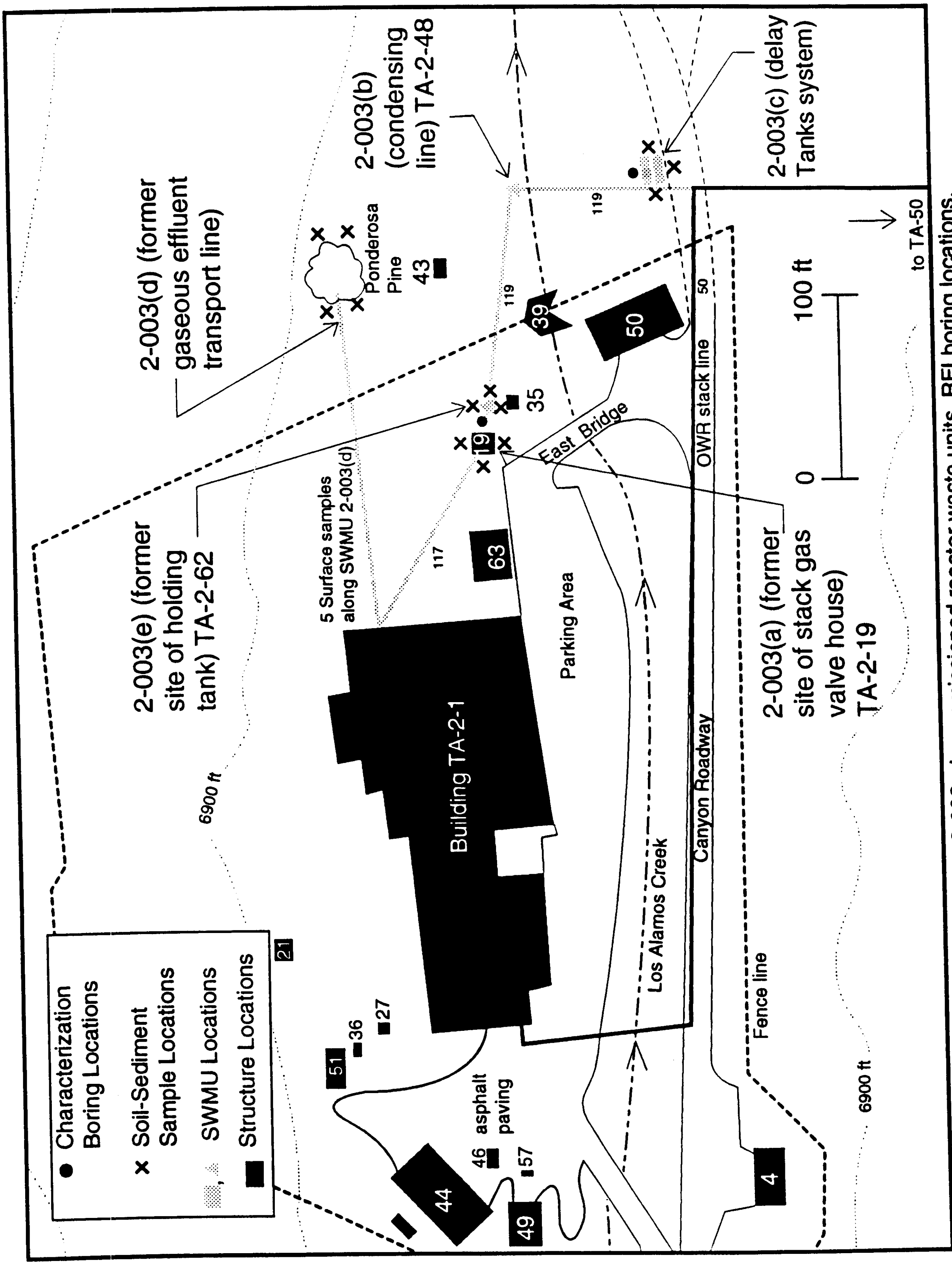


Figure 7.4-1 Proposed SWMU no. 2-003, decommissioned reactor waste units, RFI boring locations.

2. 205 ft of 3-in. stainless steel gaseous effluent transport line (line 119) and condensing trap TA-2-48 [2-003(b)] were removed in 1986 (Figure 7.4-1). Line 119 was used to carry gaseous effluent from TA-2-19 to the intersection with the Omega West Reactor (OWR) vent line (behind warehouse TA-2-50). TA-2-48 was a condensing trap and consisted of a concrete manhole superstructure and a small-diameter standpipe that intersected the gaseous effluent line (line 119) at its low point between TA-2-19 and its junction with the OWR vent line. About four times a year until 1961, materials with an average activity of about 12 μCi of cesium-137 and iodine-131 were cleaned from the trap of the stack and dumped on the alluvium in the canyon (DOE 1987, 0264). Soil was excavated around the site to expedite the removal of both structures, and cesium-137 contamination of the soil was found. Final radioactivity concentration in the leachfield at the site was 1000 pCi/g left at a depth greater than 5 ft. Much of the area was left under 7 ft of clean fill (Elder and Knoell 1986, 14-0014).
3. A delay system [2-003(c)] (Figure 7.4-1) consisted of two stainless steel tanks in series (each 1 ft in diameter, 20 ft long, and 4 ft underground). The delay tanks lay parallel to each other and provided extra volume to the effluent line to allow greater decay time for the short-lived radionuclides in the gas. The tanks were not a source of large amounts of radiation (8 mR/h maximum at contact) (Elder and Knoell 1986, 14-0014). No radioactivity was detected beneath the delay system when it was removed in 1986 (Elder and Knoell 1986, 14-0014).
4. A gaseous effluent transport line [2-003(d)] leading to the mesa top to the south consists of one section of 2 in.-diameter pipe and another section of 0.5 in.-diameter pipe (Figure 7.4-1). The SWMU report indicates that a line was removed sometime in the past, and low levels of residual activity were found where the line was located. However, a former supervisor of TA-2 operations indicated that there has been only one gaseous effluent line leading up to the stack on the mesa top. He did state that before the stack to the mesa top was built, gaseous effluents from the Water Boiler were discharged via a "garden hose" that was tied to a nearby tree (Neely 1992, 14-0008) (Figure 7.4-1). The residual contamination to which the SWMU report is alluding could have originated from this pre-mesa-top stack gaseous effluent line. This SWMU [2-003(d)] will address this "garden hose" line since the former water boiler effluent line (lines 117 and 119) is addressed in other portions of this SWMU [2-003(a) and (b)].
5. A holding tank, TA-2-62 [2-003(e)], was located near the Water Boiler for holding any reactor fluid if necessary (Figure 7.4-1) (DOE 1987, 0264). The tank was stainless steel (800-L capacity) and was placed adjacent to TA-2-19 to collect the reactor cooling water in case the water became contaminated through a breach in one of the cooling coils inside the reactor sphere. The tank was housed inside a 6 ft by 4 ft by 3 ft wooden shed. Before the tank and associated piping and

valves were removed, the radiation levels were not above background. Water found in the tank was sampled and found to be uncontaminated. The tank was drained and removed as a unit, with the exception of 40 ft of line remaining inside building TA-2-1. Soil samples taken from beneath the tank showed low activity level (63 pCi/g). This soil was removed to establish surface levels that were derived at the time to be *de minimus* (less than 25 pCi/g) (Elder and Knoell 1986, 14-0014). The report does not specify whether these radioactivity levels are due to alpha, beta, or gamma emitters.

7.4.2 Sampling Objectives and Potential Contaminants

Previous decontamination and decommissioning activities at the Water Boiler reactor have removed some of the potential contaminants of concern (COCs); however, residual contaminants were left in the soil and sediments in the areas of the SWMU sites. Therefore, a Phase I sampling plan will be initiated at SWMU 2-003 locations to confirm the presence or absence of contaminants above screening action levels, and to determine which SWMU units can be recommended for NFA and which units should undergo VCAs or Phase II investigation.

Based on the history of operations of the Water Boiler reactor at TA-2, the contaminants that are likely to be present today in soil and groundwater include tritium, cesium-137, strontium-90, technetium-99, and total uranium. Iodine-131, manganese-56, and sodium-24 were also identified as primary fission products of the reactor; however, these constituents have short half-lives and have mostly decayed into their stable, non-hazardous daughter products (xenon-131, iron-56, and magnesium-24). Therefore soil and sediment samples collected for this SWMU will be analyzed for gross alpha/beta radiation, cesium-137, strontium-90, technetium-99, and uranium as well as the other potential TA-2 contaminants as explained in Section 7.1 (see Table 7.4-1).

TABLE 7.4-1
POTENTIAL CONTAMINANTS FOR
SWMU 2-003

Potential Contaminant	Level III Method
Gross alpha/beta	Gas flow proportional counter
Gross gamma	Gamma spectrometry
Cesium-137	Gamma spectrometry
Strontium-90	Gas flow proportional counter
Technetium-99	Gamma spectrometry
Uranium (total)	ICP
Plutonium (isotopic)	Radiochemical separation and alpha spectrometry
Cobalt-60	Gamma spectrometry
Tritium	Distillation and liquid scintillation
Chromium (total)	EPA Method 6010, ICP
Mercury	EPA Method 7470, Cold Vapor

While there are no known SWMUs directly associated with the Clementine reactor, its operational history is important to environmental investigations of SWMU 2-003 and other TA-2 SWMUs due to the use of mercury and plutonium in its operations. The Clementine reactor was a plutonium-fueled, mercury-cooled, self-contained reactor. Documentation suggests there were no plutonium or mercury releases to the environment while the reactor was in operation (DOE 1987, 0264). However, both plutonium and mercury are considered extremely hazardous to the environment in very small amounts, and efforts should be made to confirm the absence (or presence) of these contaminants in the vicinity of TA-2. Therefore, soil and sediment samples collected for this SWMU, as well as other TA-2 SWMUs, will also be analyzed for plutonium (isotopic) and mercury.

In addition to these constituents there are likely to be other contaminants in the soil/sediment sampling locations for SWMU 2-003 due to the operations of the Omega West Reactor. As discussed in section 6.1.2, these contaminants include cobalt-60, tritium, and chromium (total and hexavalent). Therefore, all samples collected for SWMU 2-003 will include analyses for these constituents, as summarized in Table 7.4-1, and as quantified in Table 7.4-2.

TABLE 7.4-2
SUMMARY OF SAMPLES FOR OU 1098
PHASE I CHARACTERIZATION - SWMU 2-003

	Number of Samples	
	Soil/Sediment	Subsurface Soil*
Analytical samples	18	6
QA samples		
Rinsate blank	1	0
Field duplicate	1	0
Field blank**	1	0
Total number of samples	21	6

** An average of three soil samples will be collected per borehole*
*** Field blanks will be submitted for uranium, chromium, and mercury analyses only.*

7.4.3 SWMU 2-003 Sampling Plan

Phase I activities for SWMU 2-003 will include an engineering survey, radiological survey, surface soil/sediment sampling, and subsurface sampling. These activities will be performed following LANL Standard Operating Procedures, as listed in Table 7.3-1. The total number of samples to be collected for SWMU 2-003 is summarized in Table 7.4-2.

7.4.3.1 Engineering and Radiological Surveys

An engineering survey will be performed to locate SWMU units 2-003 (a) through (e). These data will be recorded on base maps of the area.

A radiation survey will be conducted at SWMU 2-003 to identify potential radiological anomalies along the removed underground effluent transport line, its associated structures, and the location of the former "garden hose" gas discharge line [SWMU 2-003(d)]. A walkover survey of these areas will be performed, and will continue until a radiation detector reveals no additional contaminant locations, or to a minimum distance of 5 ft along both sides of the effluent transport line, its associated structures, and "garden hose" line. This survey extent is based on knowledge of site operations and will ensure effective coverage of the area with the maximum likelihood of elevated surface and subsurface contamination levels. The locations of radiation anomalies above two standard deviations from the mean radiation level detected in these areas, and the corresponding activities, will be recorded on the field log. At these locations soil/sediment samples will be collected for mobile field lab measurement of gross alpha, beta, and gamma radiation. If point sources are identified on a case by case basis during these surveys, voluntary corrective actions (VCAs) to remove point sources and subsequent surface sampling may be implemented after permitted ER disposal facilities are available.

7.4.3.2 Surface Sampling

Surface soil and sediment samples will be collected as shown in Figure 7.4-1. Eighteen surface soil and sediment samples will be collected in Phase I at a depth of 0 to 12 in. (Figure 7.4-1). Nine of these surface samples will be collected around the former locations of the gas stack valve house (three samples), holding tank (three samples), and delay tanks (three samples) to confirm the presence or absence of residual contamination. Four of these surface samples will be collected around a tree to which the early gaseous effluent line was tied (Figure 7.4-1). At each SWMU subunit, sampling locations will be moved to areas of elevated radiological anomalies, as defined above. In addition, five surface soil and sediment samples (making a total of 18 surface samples to be collected for SWMU 2-003) will be collected along the area of the "garden hose" line, along the area of the excavated gaseous effluent line, and up to the junction of the Water Boiler line and the OWR line, in areas of elevated radioactivity determined by the radiation survey. If no elevated radioactivity is determined by the radiation survey, the five surface samples will be randomly selected over the area surveyed.

Any contaminated material found on or near the surface associated with a PRS will be treated as potential sources of contamination. Therefore, when feasible, such near-surface contaminated material will be removed as a VCA and screened for contamination. Soil and sediment that are in contact with any contaminated debris or artifact will be characterized.

7.4.3.3 Subsurface Sampling

Two characterization borings will be done at SWMU 2-003 for Phase I investigations, as shown on Figure 7.4.1. The characterization boreholes are intended to confirm the presence or absence of COCs at the decommissioned reactor waste units. These borings will be located at the former location of the gas stack valve house and holding tank, and the former location of the delay tanks.

A hollow-stem auger or other suitable drilling technique will be used to drill the characterization borings to a minimum depth of 15 ft to determine if subsurface soils/sediments have been impacted by possible SWMU releases. A 5-ft-long split-barrel core sampler will be used to collect continuous soil/rock samples in 5-ft intervals. When the core sample is retrieved, it will be screened along its entire length for radiation. One sample will be collected from each boring at a depth of 0 to 12 in. One to three samples will be collected from the remaining depth of each boring to account for potential heterogeneity in contaminant distributions within the alluvium. The samples will be taken from the section of core with the highest observed radioactivity. If no anomalous radioactivity is detected, the samples will be collected based on lithology and visual observations. The exact depth of each sample collected will be recorded in the field log. Drilling may be continued to a depth greater than 15 ft if field screening determines that two consecutive core intervals show anomalous radioactivity, as defined in section 7.4.3.1. The boreholes will be backfilled with uncontaminated material or possibly filled with cement grout after samples have been obtained. This activity will prevent vertical migration of any potential contaminants present in the sediments.

7.4.4 Sample Screening and Analysis

All sample packages will be screened for radiation using an alpha scintillometer, micro R meter, and pancake GM counter prior to shipment to the laboratory for analysis. Table 7.4-3 summarizes the number of samples to be analyzed for each specified method of analysis in Table 7.4-1 for SWMU 2-003 samples. Present screening action levels, practical quantitation limits, analytical methods, and required sample size for each analyte are presented in Table 5.1 in the Quality Assurance Project Plan for OU 1098 (Annex II of this work plan).

TABLE 7.4-3
SUMMARY OF ANALYSES FOR OU 1098
PHASE I CHARACTERIZATION - SWMU 2-003

Level III Method	Number of analyses Surface Soil/sediment	Subsurface Soil
Gas flow proportional counter	20	6
Gamma spectrometry	20	6
Radiochemical separation and alpha spectrometry	20	6
Distillation and liquid scintillation	20	6
EPA Method 6010, ICP	21	6
EPA Method 7470, Cold Vapor	21	6

7.5 SWMU NO. 2-004, DESCRIPTION OF THE STORAGE PITS AND TANKS OF THE OMEGA WEST REACTOR

7.5.1 Site Description and History

The Omega West Reactor (OWR), SWMU 2-004(a), is housed in the main TA-2 building, TA-2-1 (Figure 7.5-1). It is a plate-type reactor enriched with uranium and contained in an 8-ft-diameter, 24-ft-high closed stainless steel tank filled with cooling water. Two 28-in. hatches at the top of the reactor tank give access to the inside of the tank when the reactor is shut down.

The reactor core is a 4 ft by 9 ft array of fuel elements and experiment elements supported vertically in a grid plate and core enclosure near the bottom of the reactor tank. The reactor core loading presently being used consists of 33 fuel elements and three experiment positions. The fuel elements initially contain 220 g of uranium-235 each; however, since the elements are never changed all at once, the elements in a given core loading have from 0 to 37% of the uranium-235 decayed. In a normal cycle, two spent fuel elements are replaced with new elements every 10 wks to compensate for uranium decay (Williams 1979, 14-0036).

Two spent fuel rod racks are also contained in the OWR tank outside of the reactor core where spent fuel rods are held in 4 in.-square holders for decay. The racks are constructed in two sets and are placed around the circumference of the inside of the reactor tank. A total of 53 fuel rods can be held in the two sets of spent fuel rod racks. The spent fuel elements are each 42-5/8 in. long. The spent (or decayed) fuel elements removed from the reactor core are allowed to cool (radioactively) in the tank storage racks for at least 9 months before they are shipped for reprocessing. When a spent fuel element is first removed from the reactor core, it contains over 100 000 Ci of radioactive fission products. After 9 months of cooling (decay), the fission-product activity is reduced to about 7400 Ci, and after 3 yrs, to 2900 Ci (Williams 1979, 14-0036).

A concrete tank filled with water is used to hold the spent fuel rods when the operator transfers them between the reactor tank and a shipping container to be sent to reprocessing. The transfer pool has inner dimensions of approximately 6 ft by 10 ft by 8 ft deep, with an offset portion 3 ft by 6 ft by 4 ft deep. It can handle four spent fuel rods at one time and is operated as a closed system. In the event of necessary discharge, the liquid passes through a filter.

The off-gas system for OWR includes a small, stainless steel tank. Off-gases are routed through the tank, and vapor condenses in the tank before the gases are discharged to the line running from TA-2 to the discharge stack or "mast" (TA-2-9) on the mesa top south of TA-2 (Figure 7.5-1). The liquid from the tank is periodically pumped into a bottle and transferred to the main TA-2 liquid waste holding tank before it is transferred to TA-50 for treatment. The main contaminant in the gaseous effluent line is argon-41, and no fission products are discharged from the OWR (Neely 1992, 14-0008).

Primary cooling water from the OWR is pumped through a closed system from the reactor tank into a surge tank and then into a cooling tower where the hot (both radioactively and thermally) primary water is cooled. From the cooling

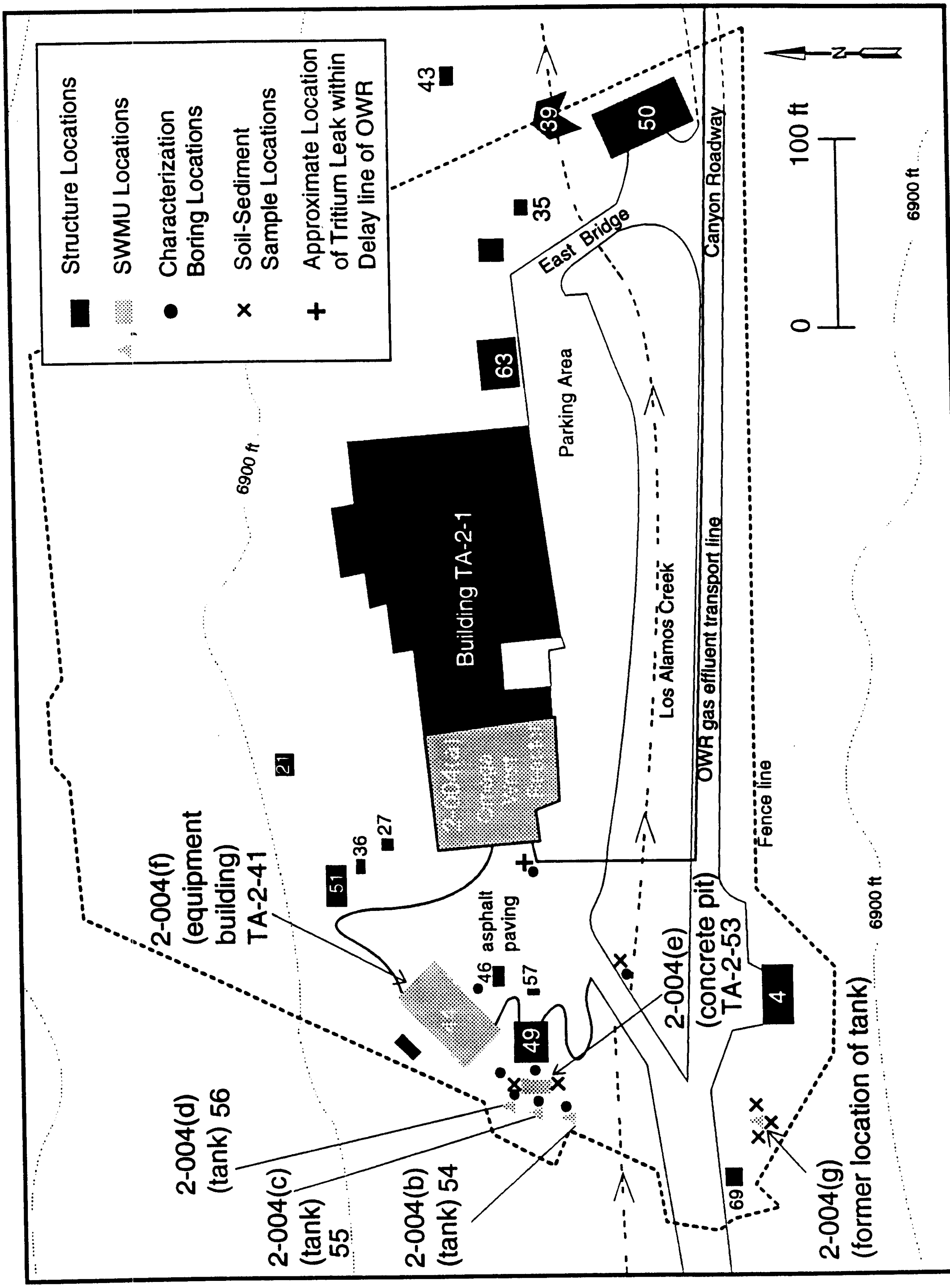


Figure 7.5-1 Proposed SWMU no. 2-004, storage pits and tanks of the Omega West Reactor, RFI boring-soil sampling locations.

tower, the water is pumped into the Buffalo chiller, which cools and separates a small amount of the primary water which then is sent through two ion exchange tanks for removal of contaminants. This cleaned water is then recirculated back into the reactor tank with the rest of the cooled primary water. Clean city water is periodically pumped through the ion exchange tanks to regenerate the filters. Effluent from this process is then pumped into three underground storage tanks. The waste in these tanks is subsequently pumped to the acid waste lines to TA-50 for treatment.

Releases of tritium resulted from a leak in the primary cooling water system at OWR. The leak occurred from a break in a weld seam in a section of the delay line running from TA-2-1 to the surge tank. This release was discovered in January 1993 and was within the Guaje Mountain fault zone. Tritium was leaking from the delay line at a rate of up to 70 gallons per day until March 1993 when the cooling water was drained from this line. Typical concentrations of tritium in the cooling water ranged from 15.7×10^6 to 20.2×10^6 pCi/L. Currently, the Laboratory plans to repair the leak in the line and resume OWR operations in 1993.

The following five SWMU units are associated with the OWR.

1. SWMU 2-004(a) is the OWR. Samples of the primary coolant water have been analyzed. One sample was taken in 1975 after having decayed over a weekend. The sample contained antimony-122, antimony-124, manganese-54, cobalt-60, chromium-51, sodium-24, and tritium. The tritium concentration was 1.7×10^7 pCi/L (HS-5 lab analysis). The sum of the other activities was approximately 1.4×10^6 pCi/L, with approximately 85% of this activity originating from the sodium-24. The tritium concentration was 5.7 times the Nuclear Regulatory Commission (NRC) radiation concentration guide for drinking water, and the sodium-24 alone was 40 times the radiation concentration guide for release to the public (Wenz 1975, 14-0035). Other analyses have shown similar activity in the primary coolant water. Neely (1992, 14-0008) stated that no chemical solvents have been used in the reactor tank. This SWMU will not be assessed until the OWR is decommissioned.
2. SWMUs 2-004(b), (c), and (d) are three 1200-gal. stainless steel underground storage tanks used to store flushed effluents from the ion exchange system. Primary reactor cooling water is not stored in these tanks. A site operator kept logs from 1970 to 1976 on the activity of contaminated water in these tanks. His logs show that, on average, the activity of the water in contact with the tank was around 1 mR/h. However, there were at least six incidents recorded in these logs in which the water in the tank had activity higher than 50 mR/h. Total gamma activity within the tanks was typically around 10^5 pCi/L, mostly due to the cobalt-60 isotope. Other isotopes found in the water included manganese-54, chromium-51, scandium-46, and antimony-124. Neely also stated that solvents were not likely to have been used in the tanks because the tanks have a rubberized liner that keep residue precipitation to a minimum (Neely 1992, 14-0008).

3. SWMU 2-004(e) is an underground concrete pit, known as the acid pit (TA-2-53), which contains the pumps and valve system by which the effluents are transferred from the three storage tanks to the acid waste lines. It is constructed of reinforced concrete and is 7 ft by 11 ft by 7 ft deep. Neely (1992, 14-0008) stated that small spills of regenerant water were common within the acid pit, as well as on soils surrounding the pit.
4. SWMU 2-004(f) is an equipment building, TA-2-44, which contains the main circulating pump for the reactor cooling water, several other pumps, the Buffalo chiller, and the tanks for the ion exchange system. Neely (1992, 14-0008) stated that small spills of primary coolant water as well as regenerant water from the ion exchange system were common. The water emptied through a floor drain in the building. In addition, the equipment building was commonly cleaned by employees who hosed down the walls and floors when contamination was noted. This water was discharged through the front door of the building and directly to the creek.
5. SWMU 2-004(g) is a 300-gal. portable tank that was located on a platform near the guard station (TA-2-12). The tank was inactive for 3 yrs before it was removed (date of removal unknown). However, when in use, the tank was used to store liquids from the other tanks in an emergency. A hoist lifted the platform and tank onto a truck for transport to TA-50.

A DOE report (DOE 1987, 0264) also documents several incidents of accidental release of contaminated water into Los Alamos Canyon. In February 1964, 125 gal. of slightly acidic liquid waste of short-lived isotopes containing 2 mCi chromium-51, 0.43 mCi antimony-124, 0.2 mCi iron-59, and 0.2 mCi manganese-54 were reported to have been discharged from the OWR storage tanks into Los Alamos Canyon. How often this type of discharge occurred is not known. In May 1964, 1000 gal. of liquid from the resin bed regeneration (ion exchange system) apparently was discharged. It contained short-lived radionuclides and 2.5 mCi of manganese-54 (Dean 1964, 14-0027). In 1970, a monitoring report stated that water from the acid pit [SWMU 2-004(e)] was pumped into the creek through a concrete trench. Before decontamination, radiation levels as high as 30 mR/h was measured in the trench. In 1972, water was reported to have been dumped into a floor drain that emptied into the creek. Radionuclides sodium-24, manganese-56, and copper-64 were identified in the dump.

Downstream from OWR and DP outfalls in Los Alamos Canyon, samples have been taken for radionuclides and chemicals. In 1954, soil samples were taken downstream from OWR, and beta and/or gamma radiation above background was detected at the points where fluid was leaving the site (DOE 1987, 0264). In 1958 soil samples in Omega Canyon showed gross gamma activity decreasing from the outfall to a point about 1.8 miles downstream (DOE 1987, 0264). In 1969, a report stated that "at no time did analyses indicate concentrations approaching published radiological or chemical limits, with the exceptions of hexavalent chromium which is being discharged continuously in effluent water" (Kennedy 1969, 14-0026). In 1985, at a point 100 yd downstream from TA-2, cesium-137 levels were observed in water at or near background (ESG 1986). Several hundreds of feet down Los Alamos Canyon from TA-2, cesium-137 in sediment was 6.2 ± 0.90 pCi/g, whereas up the canyon, concentrations measured 0.34 ± 0.09 pCi/g (ESG 1986).

7.5.2 Sampling Objectives and Potential Contaminants

SWMU 2-004 is associated with active operations; however, contaminants (primarily tritium) have been released to the soil in the immediate vicinity of the SWMU through the years of OWR operations. Subsurface contamination may be present around the storage tanks [2-004(b), (c), and (d)] and acid pit [2-004(e)], and surface contamination may be present downslope from the front door of building TA-2-44 [2-004(f)] and in the vicinity of the portable tank [2004(g)]. Investigation of OWR [2-004(a)] is deferred until the decontamination and decommissioning of the reactor. Incidental releases of contaminants into Los Alamos Creek will be addressed in the baseline characterization of OU 1098. A Phase I sampling plan will be initiated at SWMU 2-004(b) through (g) locations to confirm the presence or absence of contaminants above screening action levels and to determine which SWMU units can be recommended for no further action (NFA) and which units should undergo a voluntary corrective action (VCA) or Phase II investigation.

Based on the history of operations at OWR, the contaminants likely to be present today in soil and groundwater include fission products from OWR, most notably cobalt-60, strontium-90, cesium-137, and tritium. Chromium also has been released by OWR operations, as described in Section 7.6 of this work plan. In addition, other contaminants are likely to be present resulting from the two other reactors that were in operation at TA-2. As discussed in section 6.1.2, these contaminants include gross alpha/beta radioactivity, cesium-137, strontium-90, technetium-99, total uranium, isotopic plutonium, and mercury. Therefore, all samples collected for SWMU 2-004 will include analyses for these constituents in addition to the other TA-2 potential contaminants explained in Section 7.1, as summarized in Table 7.5-1.

TABLE 7.5-1
POTENTIAL CONTAMINANTS FOR SWMU 2-004

Potential contaminants	Level III Method
Gross alpha/beta	Gas flow proportional counter
Gross gamma	Gamma spectrometry
Cesium-137	Gamma spectrometry
Strontium-90	Gas flow proportional counter
Technetium-99	Gamma spectrometry
Uranium (total)	ICP
Plutonium (isotopic)	Radiochemical separation and alpha spectrometry
Cobalt-60	Gamma spectrometry
Tritium	Distillation and liquid scintillation
Chromium (total)	EPA Method 6010, ICP
Mercury	EPA Method 7470, Cold Vapor

7.5.3 SWMU No. 2-004 Sampling Plan

Phase I activities for SWMU 2-004 will include an engineering survey, radiological survey, surface soil/sediment sampling, and subsurface sampling. These activities will be performed following LANL Standard Operating Procedures, as listed in Table 7.3-1. The total number of samples to be collected for SWMU 2-004 is summarized in Table 7.5-2.

TABLE 7.5-2
SUMMARY OF SAMPLES FOR OU 1098
PHASE I CHARACTERIZATION - SWMU 2-004

	Number of Samples	
	Soil/Sediment	**Subsurface Soil***
Analytical samples	6	24
QA samples		
Rinsate blank	0	1
Field duplicate	0	1
Field blank**	0	1
Total number of samples	6	27

** An average of three soil samples will be collected per borehole*
*** Field blanks submitted for mercury and chromium analyses only*

7.5.3.1 Engineering and Radiological Surveys

An engineering survey will be performed to located SWMU units 2-004(b) through (g). These data will be recorded on base maps of the area.

A walkover radiation survey will be conducted at SWMU units 2-004(b) through (g) to identify potential radiological anomalies, and will continue until detectors reveal no additional contaminant locations. Locations of elevated activity, defined as greater than two standard deviations from the mean radiation level detected in the vicinity of TA-2, will be flagged and recorded in the field log with corresponding activities. At these locations, soil/sediment samples will be collected for mobile field lab measurement of gross alpha, beta, and gamma radiation. If point sources are identified on a case by case basis during these surveys, VCAs to remove point sources and subsequent surface sampling may be implemented, after permitted ER disposal facilities are available.

7.5.3.2 Surface Sampling

Surface soil and sediment samples will be collected as shown in Figure 7.5-1, in areas that will minimize the impact on operations at the OWR during Phase I activities. Sampling locations are selected based on process knowledge of site operations and will ensure effective coverage of the areas with the maximum likelihood of elevated contamination levels. Six surface soil/sediment samples will be collected at a depth of 0 to 12 in. Two of these surface samples will be collected around the acid pit [2004(e)] to detect any possible contamination associated with spills of regenerant fluid onto surrounding soils. One surface sample will be collected at the point where runoff coming from the equipment building [SWMU 2-004(f)] joins the stream channel to detect presence or absence of contamination associated with decontamination of the building. Three surface samples will be collected at the former location of the 300-gal. portable tank [SWMU 2-004(g)] to look for possible contamination occurring from spills from the portable tank. At all SWMU subunits, sampling locations will be moved to areas of radiological anomalies, as defined above, if detected.

Any contaminated material on or near the surface will be treated as a potential source of contamination. Therefore, when feasible, such near-surface contaminated material will be removed as a VCA. Soil samples that are in contact with any contaminated material will be characterized.

7.5.3.3 Subsurface Sampling

Subsurface soil samples will be collected from eight characterization borings at SWMU 2-004(b) through (g) to permit initial assessment of potential decontamination during Phase I activities. The characterization boreholes are intended to detect presence or absence of potential COCs at the acid pit and tanks of the OWR, along piping running between TA-2-44 and the acid pit and the cooling tower, and in front of building TA-2-44. These boreholes will be placed according to Figure 7.5-1, and will be moved to locations of radiological anomalies, if detected in the radiological survey.

A hollow-stem auger or other suitable technique will be used to drill the characterization borings to a minimum depth of 15 ft to determine if subsurface soils have been contaminated. A 5-ft-long split-barrel core sampler will be used to collect continuous soil/rock samples in 5-ft intervals. When the core sample is retrieved, it will be screened along its entire length for radiation. One sample will be collected from each boring at a depth of 0 to 12 in. One to three samples will be collected from the remaining depth of each boring, with at least one taken from the section of core with the highest observed radioactivity. If no anomalous radioactivity is detected, the samples will be collected based on lithology and visual observations. The exact depth of each sample collected will be recorded in the field log. Drilling may be continued to a depth greater than 15 ft if field screening determines that two consecutive core intervals show anomalous radioactivity, as defined in section 7.5.3.1.

7.5.4 Sample Screening and Analysis

All sample packages will be screened for radiation using an alpha scintillometer, micro R meter, and pancake GM counter prior to shipment to the laboratory for analysis. Table 7.5-3 summarizes the number of samples to be analyzed for each specified method of analysis in Table 7.5-1 for SWMU 2-004 samples. Present screening action levels, practical quantitation limits, analytical methods, and required sample size for each analyte are presented in Table 5.1 in the Quality Assurance Project Plan for OU 1098 (Annex II of this work plan).

TABLE 7.5-3
SUMMARY OF ANALYSES FOR OU 1098
PHASE I CHARACTERIZATION - SWMU 2-004

Level III Method	Number of analyses Surface Soil/sediment	Number of analyses Subsurface Soil
Gas flow proportional counter	6	26
Gamma Spectrometry	6	26
Radiochemical separation and alpha spectrometry	6	26
Distillation and liquid scintillation	6	26
EPA Method 6010, ICP	6	27
EPA Method 7470, Cold Vapor	6	27

7.6 SWMU 2-005, DESCRIPTION OF COOLING TOWER DRIFT LOSS

7.6.1 Site Description and History

From 1957 to the mid-1970s, potassium dichromate was added to the cooling water in the Omega West Reactor (OWR) cooling tower to prevent corrosion of aluminum heat exchangers (Neely 1992, 14-0008). Drift loss of potassium dichromate was discharged mainly to areas north and east of building TA-2-1 due to prevailing northeasterly wind direction (Figure 7.6-1) (DOE 1987, 0264). In 1971 measurements indicated that 0.05 lb of hexavalent chromium per hour of operation was being lost due to cooling tower operations. Calculations based on archival data indicate that approximately 5000 lb of chromium may have been discharged over a 17-yr period to the soil and sediments adjacent to building TA-2-1 (assumes 0.05 lb of chromium loss/hour/120 hours per week). Potassium dichromate use was discontinued in the mid-1970s when the aluminum heat exchanges were replaced by stainless steel heat exchangers.

7.6.2 Sampling Objectives and Potential Contaminants

Potassium dichromate was discharged via the cooling tower for a 17 yr period, and chromium contamination in soils and sediments throughout TA-2 is expected. Phase I investigations for SWMU 2-005, in addition to confirming the presence or absence of chromium in surface soils, will determine the extent of contamination in support of a possible voluntary corrective action (VCA) or eventual corrective measures study (CMS), and will also estimate the average level of contamination in support of an eventual baseline risk assessment.

The potential contaminant of concern (COC) for this SWMU is chromium. Total chromium will be analyzed for all samples. If the total chromium concentrations are greater than the chromium VI screening action level of 400 ppm, further studies will be done to evaluate what proportion of the total chromium is hexavalent chromium.

Sampling for this SWMU has been integrated with sampling of all other SWMUs for TA-2. All samples collected for TA-2 (excluding the gaseous effluent stack on the mesa top south of TA-2) will be analyzed for chromium.

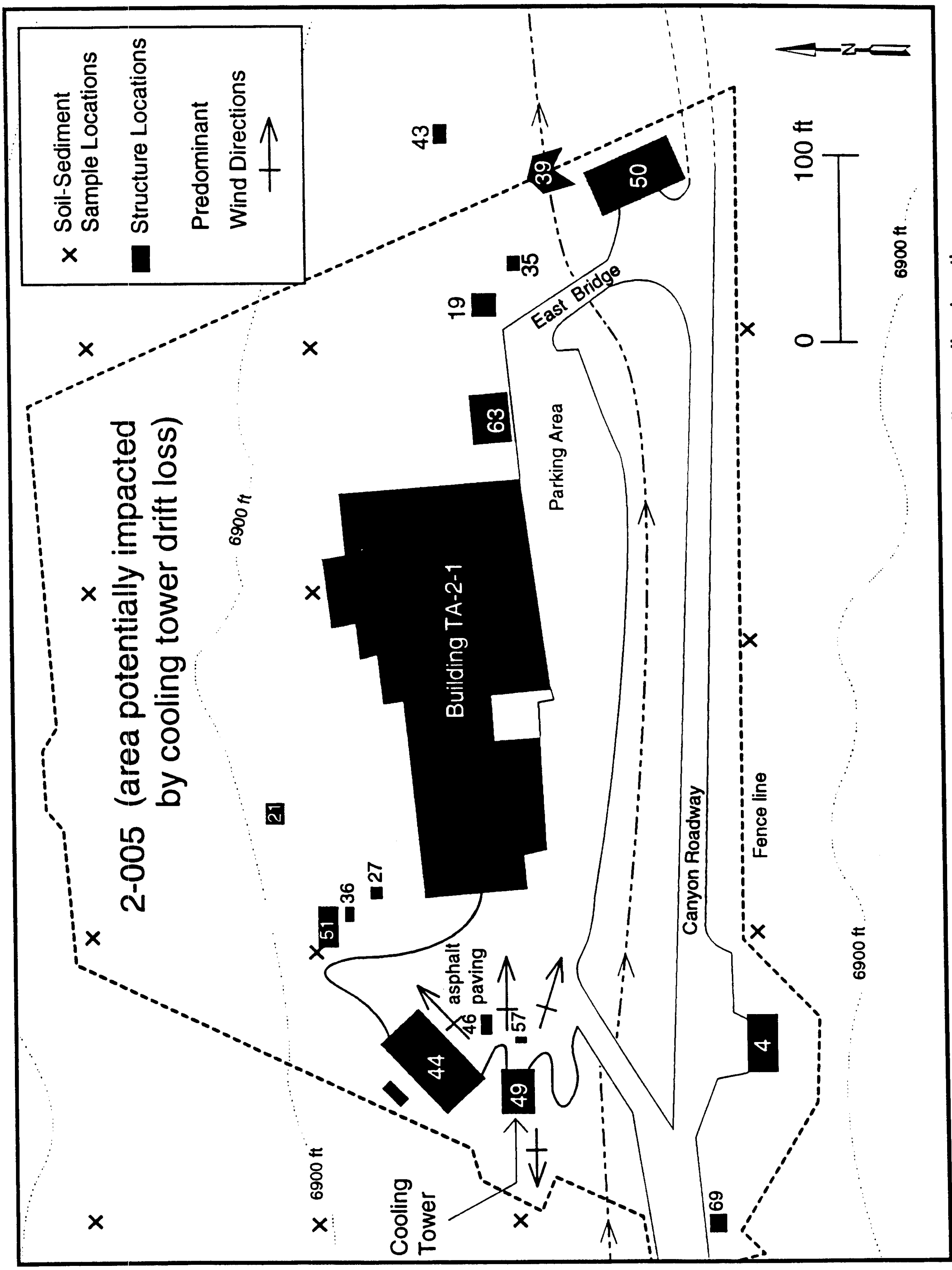


Figure 7.6-1 Proposed SWMU no. 2-005, cooling tower drift loss, RFI boring-soil sampling locations.

TABLE 7.6-1
POTENTIAL CONTAMINANTS FOR
SWMU 2-005

Potential Contaminant	Level III Method
Gross alpha/beta	Gas flow proportional counter
Gross gamma	Gamma spectrometry
Cesium-137	Gamma spectrometry
Strontium-90	Gas flow proportional counter
Technetium-99	Gamma spectrometry
Uranium (total)	ICP
Plutonium (isotopic)	Radiochemical separation and alpha spectrometry
Cobalt-60	Gamma spectrometry
Tritium	Distillation and liquid scintillation
Chromium (total)	EPA Method 6010, ICP
Mercury	EPA Method 7470, Cold Vapor

7.6.3 SWMU 2-005 Sampling Plan

Phase I activities for SWMU 2-005 will be limited to surface soil/sediment sampling around TA-2. The surface sampling will be performing following LANL Standard Operating Procedures, as listed in Table 7.3-1. The total number of samples to be collected for SWMU 2-005 is summarized in Table 7.6-2.

TABLE 7.6-2
SUMMARY OF SAMPLES FOR OU 1098
PHASE I CHARACTERIZATION - SWMU 2-005

	Number of Samples Soil/Sediment
Analytical samples	12
QA samples	
Rinsate blank	1
Field duplicate	1
Field blank	1
Total number of samples	15

7.6.3.1 Surface Sampling

Surface soil and sediment samples will be collected, as shown in Figure 7.6-1, to a depth of 0 to 12 in. A total of 12 samples will be collected from the TA-2 area. The number of samples is based on recommendations presented in Appendix H (Statistical Sampling and Data Analysis for Environmental Restoration) of the IWP (LANL 1992, 0768). Reconnaissance sampling was chosen as the most appropriate sampling approach for these areas to address the question of whether contamination is present above screening action levels. Twelve samples will be collected for SWMU 2-005, reflecting an estimated fraction of contaminated area around 25 percent and a required confidence level of 95 percent. Sampling locations are set out in a grid over TA-2 such that grid spacings are approximately 150 ft apart, and sampling locations do not overlap with other SWMU locations.

7.6.4 Sample Screening and Analysis

All sample packages will be screened for radiation, using an alpha scintillometer, micro R meter, and pancake GM counter prior to shipment to the laboratory for analysis. Table 7.6-3 summarizes the number of samples to be analyzed for each specified method of analysis in Table 7.6-1 for SWMU 2-005 samples. Present screening action levels, practical quantization limits, analytical methods, and required sample size for each anolyte is presented in Table 5.1 in the Quality Assurance Project Plan for OU 1098 (Annex II of this work plan).

TABLE 7.6-3
SUMMARY OF ANALYSES FOR OU 1098
PHASE I CHARACTERIZATION - SWMU 2-005

Level III Method	Number of analyses Surface soil/sediment
Gas flow proportional counter	14
Gamma spectrometry	14
Radiochemical separation and alpha spectrometry	14
Distillation and liquid scintillation	14
EPA Method 6010, ICP	15
EPA Method 7470, Cold Vapor	15

7.7 SWMU NO. 2-006, DRAINS

7.7.1 Site Description and History

SWMU 2-006 consists of five subparts [(a) through (e)] (Figures 7.7-1 and 7.7-2):

1. An active French drain [2-006(a)] is associated with the stack located on the mesa top south of Los Alamos Canyon (Figure 7.7-1). The stack is part of the gaseous effluent line from the Omega West and former Water Boiler reactors. This drain collects condensate that flows down the stack, and the liquid is subsequently released to the soil. The drain is constructed of 2-in. stainless steel which runs about 20 ft northwest of the stack into a dry well. Gaseous argon-41 is the primary contaminant in the effluent line coming from the OWR (Neely 1992, 14-008). Cesium-137 and iodine-131 (average activity of about 12 µCi) have been found in other traps in the effluent line in the canyon, which are products from the Water Boiler. It is likely that low levels of these radionuclides were discharged into the soil around the stack from the French drain.
2. An acid waste line [2-006(b)] originates from several laboratories in building TA-2-1. The line was a 4 in. Duriron pipe with Ookum fittings and lead joints. The line's discharge point to the creek was covered with a 1/4 in. by 1/4 in. mesh rodent screen. The discharge point to the creek, as seen on Engineering Drawings 4-C-701 and C-1750, is shown on Figure 7.7-2. This line discharged chemical waste to the creek and was abandoned in place at least 25 yr ago (DOE 1987, 0264). The exact chemicals discharged through this line and any residual contamination associated with the structure are unknown.
3. A combined drain line from several labs and a chemical room in building TA-2-1 constitute 2-006(c). According to the SWMU report, these lines drain to the creek. However, according to Engineering Drawing C-1750, these lines do not drain to the creek, but into a disposal unit. It is likely this disposal unit was the septic tank, TA-2-43, since the location of these lines coincide with sanitary sewer lines shown on Engineering Drawing 4-C-701. Additionally, these lines are shown to receive sanitary wastes, and it is doubtful sanitary wastes would be discharged directly to the creek outside of building TA-2-1. The SWMU report indicates these lines are still active, and thus they now probably drain into the current septic system.
4. A drain from building TA-2-1 which drains the reactor control room air conditioner, sink, back flow preventer valve, and water fountain constitute 2-006(d). The SWMU report indicates that this drain discharges to the creek. However, no outlet for such

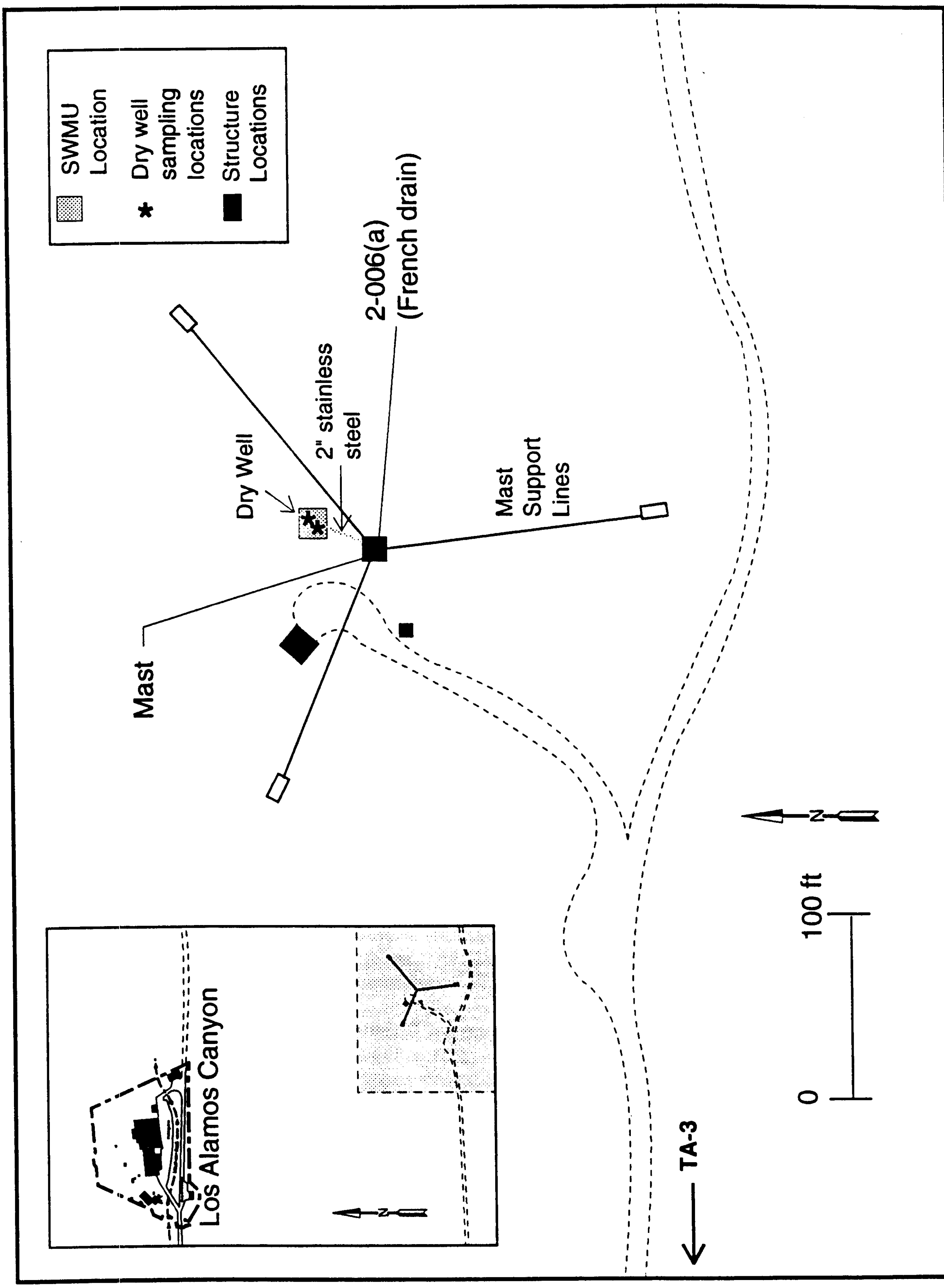


Figure 7.7-1 Proposed SWMU no. 2-006(a) French drain, RFI sampling locations.

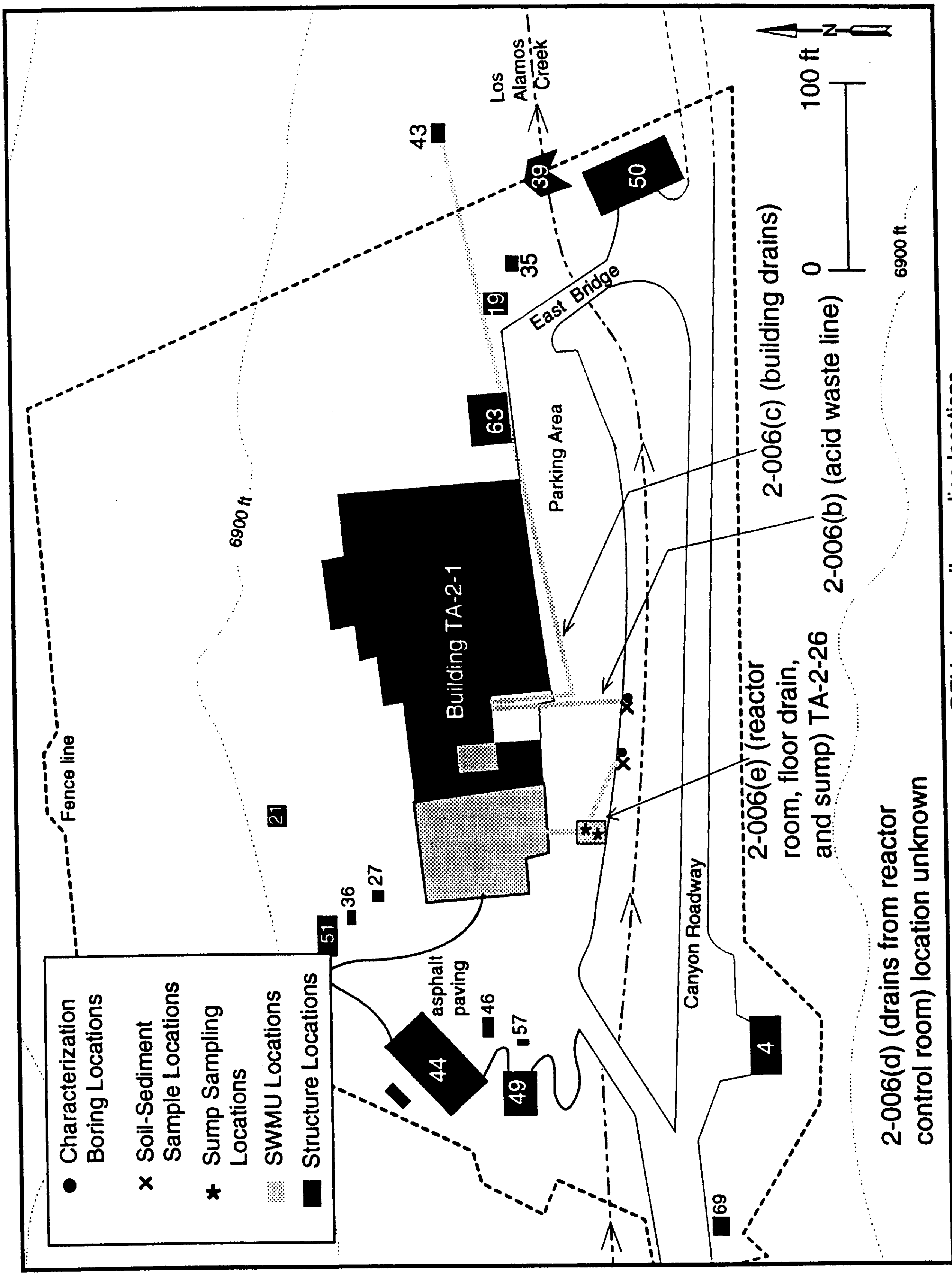


Figure 7.7-2 Proposed SWMU no. 2-006, drains, RFI boring-soil sampling locations.

a drain is seen on engineering drawings. The exact location of this drain is unknown, and it is unknown at this time if any contamination is associated with this drain.

5. A drain in the floor and mezzanine of the OWR reactor room constitutes 2-006(e). There have been several small spills of primary coolant water from the OWR in the reactor room in the past (Neely 1992, 14-0008). This drain discharges to a sump, also called a salvage basin (TA-2-26), that overflows to the creek (Figure 7.7-2). These spills occurred when hatches to the reactor tank were opened and condensed reactor water spilled onto the top of the reactor tank and through the 2-006(e) drain. Thus, it is likely this drain and the related sump are radioactively contaminated with long-lived fission products to a small degree.

7.7.2 Sampling Objectives and Potential Contaminants

SWMU 2-006(a), (b), and (e) will be sampled during Phase I activities to determine the presence or absence of potential contaminants of concern (COCs), which will ascertain whether these drains can be recommended for NFA or if they should undergo a VCA or Phase II investigation. SWMU 2-006(c) will not be sampled because its only outfall has been through the septic tank TA-2-43, which is addressed in SWMU 2-007 (section 7.8). SWMU 2-006(d) will not be sampled because the exact location of the drain is unknown and there is no evidence of a discharge outlet to the creek from the vicinity of the room where this drain is said to be located.

Contaminants likely to be present at the active French drain [SWMU 2-006(a)] originate from condensate which flows down the stack and is subsequently released to the environment. Since this stack has been used for both the Water Boiler and Omega West reactors, fission product constituents from both of these reactors are likely to be present. Therefore, samples from the area of the French drain will be analyzed for gross alpha/beta, gross gamma, cesium-137, strontium-90, technetium-99, total uranium, cobalt-60, and tritium.

The acid waste line [SWMU 2-006(b)] discharged chemical waste to the creek from several laboratories in building TA-2-1. Potential COCs include inorganics and semivolatile organics. Chromium, which is a potential COC for all areas at TA-2, is included in the inorganics analysis. Additionally, collected samples will be analyzed for mercury, plutonium, and fission products from both the Omega West and Water Boiler reactors to assess radioactive contamination in the creek sediments downstream from outfalls which have likely released these contaminants in the past [i.e., SWMU 2-006(e) and SWMU 2-008(a)].

Potential COCs for SWMU 2-006(e) are tritium and fission products including cobalt-60. Additionally, samples will be analyzed for fission products from the Water Boiler reactor, as well as plutonium, chromium, and mercury, to assess contamination in creek bed sediments due to overall TA-2 operations. Table 7.7-1 summarizes the constituents to be analyzed for samples collected from SWMUs 2-006(a), (b), and (e).

TABLE 7.7-1
POTENTIAL CONTAMINANTS FOR
SWMU 2-006

Potential Contaminant	Level III Method
Gross alpha/beta	Gas flow proportional counter
Gross gamma	Gamma spectrometry
Cesium-137	Gamma spectrometry
Strontium-90	Gas flow proportional counter
Technetium-99	Gamma spectrometry
Uranium (total)	ICP
Plutonium (isotopic)	Radiochemical separation and alpha spectrometry
Cobalt-60	Gamma spectrometry
Tritium	Distillation and liquid scintillation
Chromium (total)	EPA Method 6010, ICP
Mercury	EPA Method 7470, Cold Vapor
Inorganics	EPA Method 6010, ICP
Semivolatile organics	EPA Method 8270

7.7.3 SWMU No. 2-006 Sampling Plan

Phase I activities for SWMU 2-006 will include an engineering survey, radiological survey, surface soil/sediment sampling, and subsurface sampling. These activities will be performed following LANL Standard Operating Procedures, as listed in Table 7.3-1. The total number of samples to be collected for SWMU 2-006 is summarized in Table 7.7-2.

TABLE 7.7-2
SUMMARY OF SAMPLES FOR OU 1098
PHASE I CHARACTERIZATION - SWMU 2-006

	Number of Samples		
	Soil/Sediment	Subsurface	Soil/Sump/Dry Well
Analytical samples	2	6	4
QA samples			
Rinsate blank	0	1	1
Field duplicate	0	1	1
Field blank*	0	1	1
Total number of samples	2	9	7

* *Field blanks will be submitted for non-radiological analyses only.*

7.7.3.1 Engineering, Radiological, and Metal Detection Surveys

An engineering survey will be performed to locate SWMU units 2-006(a), (b), and (e). These data will be recorded on base maps of the area.

A walkover radiation survey will be done in the creek bed, in the area within at least 5 ft of the outfalls for SWMUs 2-006(b) and (e), to identify radiological anomalies. Locations of elevated activity, defined as greater than two standard deviations from the mean radiation level detected in the vicinity of TA-2, will be flagged and recorded in the field log with corresponding activities. At these locations, soil/sediment samples will be collected for mobile field lab measurement of gross alpha, beta, and gamma radiation. If point sources are identified, on a case by case basis, during this survey, voluntary corrective actions (VCAs) to remove point sources and subsequent surface sampling may be implemented, if permitted. A metal detection survey will be done for SWMU 2-006(a) to locate the stainless steel pipe which runs to the dry well 20 ft northwest of the gaseous effluent stack. This will be done in an attempt to locate the dry well, which will be at the end of the pipe, in order to sample soil beneath the structure.

7.7.3.2 Surface Sampling

Surface soil and sediment samples will be collected as shown in Figure 7.7-2 to a depth of 0 to 12 in. One surface sample will be collected at each of the outfalls of 2-006(b) and (e) (for a total of two surface samples). Sampling locations will be moved to areas of radiological anomalies, as defined above, if detected.

Any contaminated material on or near the surface will be treated as a potential source of contamination. Therefore, when feasible, such near-surface contaminated material will be removed as a VCA. Soil samples that are in contact with any contaminated material will be characterized.

7.7.3.3 Subsurface Sampling

Subsurface soil samples will be collected from two borings at the outfalls of 2-006(b) and (e), as shown on Figure 7.7-2. These samples will be collected to confirm presence or absence of potential COCs at depth in the creek bed. The boring locations will be moved to locations of radiological anomalies, as defined above, if detected.

A hollow-stem auger will be used to drill the characterization borings to a minimum depth of 15 ft to determine if subsurface soils have been contaminated. A 5-ft-long split-barrel core sampler will be used to collect continuous soil/rock samples in 5-ft intervals. When the core sample is retrieved, it will be screened along its entire length for radiation. One sample will be collected at a depth of 0 to 12 in. from each boring. One to three samples will be collected from the remaining depth of each boring, with at least one taken from the section of core with the highest observed radioactivity. If no anomalous radioactivity is detected, the samples will be collected based on lithology and visual observations. The exact depth of each sample collected will be recorded in the field log. Drilling may be continued to a depth greater than 15 ft if field screening determines that two consecutive core intervals show anomalous radioactivity, as defined in section 7.7.3.1.

7.7.3.4 Sump and Dry Well Sampling

Two samples will be taken from the sump (TA-2-26), also known as a salvage basin or hold up basin, south of TA-2-1 [2-006(e)]. Engineering drawings show a manhole cover over the location of the sump. This manhole cover will be removed and two sludge/sediment samples will be collected from the sump according to LANL procedures listed in Table 7.3-1.

Two samples will be taken from the dry well associated with the French drain to the gaseous effluent stack on the mesa top south of TA-2 [2-006(a)]. A geophysical detector survey will be done, as described in section 7.7.3.1, to find the stainless steel pipe which leads to the dry well. When the dry well is located, the top of the structure will be lifted and two sludge/sediment samples will be collected according to LANL procedures listed in Table 7.3-1.

7.7.4 Sample Screening and Analysis

All sample packages will be screened for radiation using an alpha scintillometer, micro R meter, and pancake GM counter prior to shipment to the laboratory for analysis. Table 7.7-3 summarizes the number of samples to be analyzed for each specified method of analysis in Table 7.7-1 for SWMU 2-006 samples. Present screening action levels, practical quantitation limits, analytical methods, and required sample size for each analyte are presented in Table 5.1 in the Quality Assurance Project Plan for OU 1098 (Annex II of this work plan).

TABLE 7.7-3
SUMMARY OF ANALYSES FOR OU 1098
PHASE I CHARACTERIZATION - SWMU 2-006

Level III Method	Number of analyses		
	Surface Soil/sediment	Subsurface Soil	Sump/ Dry Well
Gas flow proportional counter	2	8	6
Gamma spectrometry	2	8	6
Radiochemical separation and alpha spectrometry	2	8	7
Distillation and liquid scintillation	2	8	6
EPA Method 6010, ICP	2	9	7
EPA Method 7470, Cold Vapor	2	9	7
EPA Method 8270*	1	3	0

**EPA Method 8270 - Semivolatile organics will be analyzed only for samples collected for SWMU 2-006(b)*

7.8 SWMU 2-007, DESCRIPTION OF DECOMMISSIONED SEPTIC SYSTEM

7.8.1 Site Description and History

Engineering drawing ENG-R 391 shows that septic tank TA-2-43 (SWMU 2-007) received sanitary sewer wastes from building TA-2-1 (Figure 7.8-1). The tank was disconnected from the sanitary sewer line in the 1950s. In the mid-1970s, the building TA-2-1 sanitary system was connected to the TA-41 treatment plant (DOE 1987, 0264). It is unknown where sanitary sewer wastes were disposed of from the 1950s to the mid-1970s at TA-2. In the years before the tank's removal in 1986, it was semiactive when water was routinely pumped into it from spring-fed water leakage into the basement of TA-2-1. This source was verified by dye-tracing prior to the tank's removal (Elder and Knoell 1986, 14-0014). The septic tank was constructed of reinforced concrete and was approximately 13 ft by 8 ft by 6 ft deep. The overflow from the tank went to a 6-in. clay pipe drainline with an outfall. Evidence of a leach field near the septic tank's outfall was noted during the Phase I decommissioning effort of the water boiler reactor. The area of the leach field had residual radioactivity. This area is discussed further in SWMU 2-009 (Operational Releases).

A 1957 memo indicated that the effluent from the tank was contaminated (DOE 1987, 0264). In 1967, a memo (Fowler 1967, 14-0016) indicated that the tank sludge and effluent were contaminated. Sewage sludge samples from inside the tank showed 62 disintegration/minute/milliliter (dpm/ml) (28, 000 pCi/L) gross alpha predominantly from uranium-235, approximately 6000 dpm/ml (2,703,000 pCi/L) gross beta, of which approximately 350 dpm/ml was from strontium-90, and 1100 dpm/ml (500,000 pCi/L) gross gamma was from cesium-137. Samples from outside the tank showed 44 dpm/ml (20,000 pCi/L) gross alpha from uranium-235, 3000 dpm/ml (1,364,000 pCi/L) gross beta, of which approximately 30 dpm/ml (14,000 pCi/L) came from strontium-90, and approximately 730 dpm/ml (332,000 pCi/L) gross gamma came from cesium-137. In October 1967, the sludge from this septic tank was resampled and then removed in 55-gal. drums to the Mesita del Buey dump ground. Radiation levels of the sludge prior to removal ranged from 0.09 mR/h to 1.5 mR/h contact with the containers (open shield). Using a 400-channel analyzer, workers identified cesium-137 and cobalt-60. In 1979, the septic tank and its associated drainage were again noted to be contaminated (DOE 1987, 0264). The source of the contamination is thought to be either from laboratories within building TA-2-1 or from a chemical waste shack (SWMU no. 2-010) connected to the main sewer.

In 1986, the septic tank and its associated clay pipe were removed as part of the Phase I decommissioning effort of the water boiler reactor. At that time no contamination was detected in the tank. Before removal, samples of the water overflowing the septic tank and a sludge sample from the bottom of the tank showed no detectable radioactivity (alpha, beta, or gamma). The septic tank and the clay line draining the tank overflow to the stream were removed. The line was removed from depths of 3 to 8 ft where it angled across the area east of the septic tank (Figure 7.8-1). The 6-in. clay pipe between the building TA-2-1

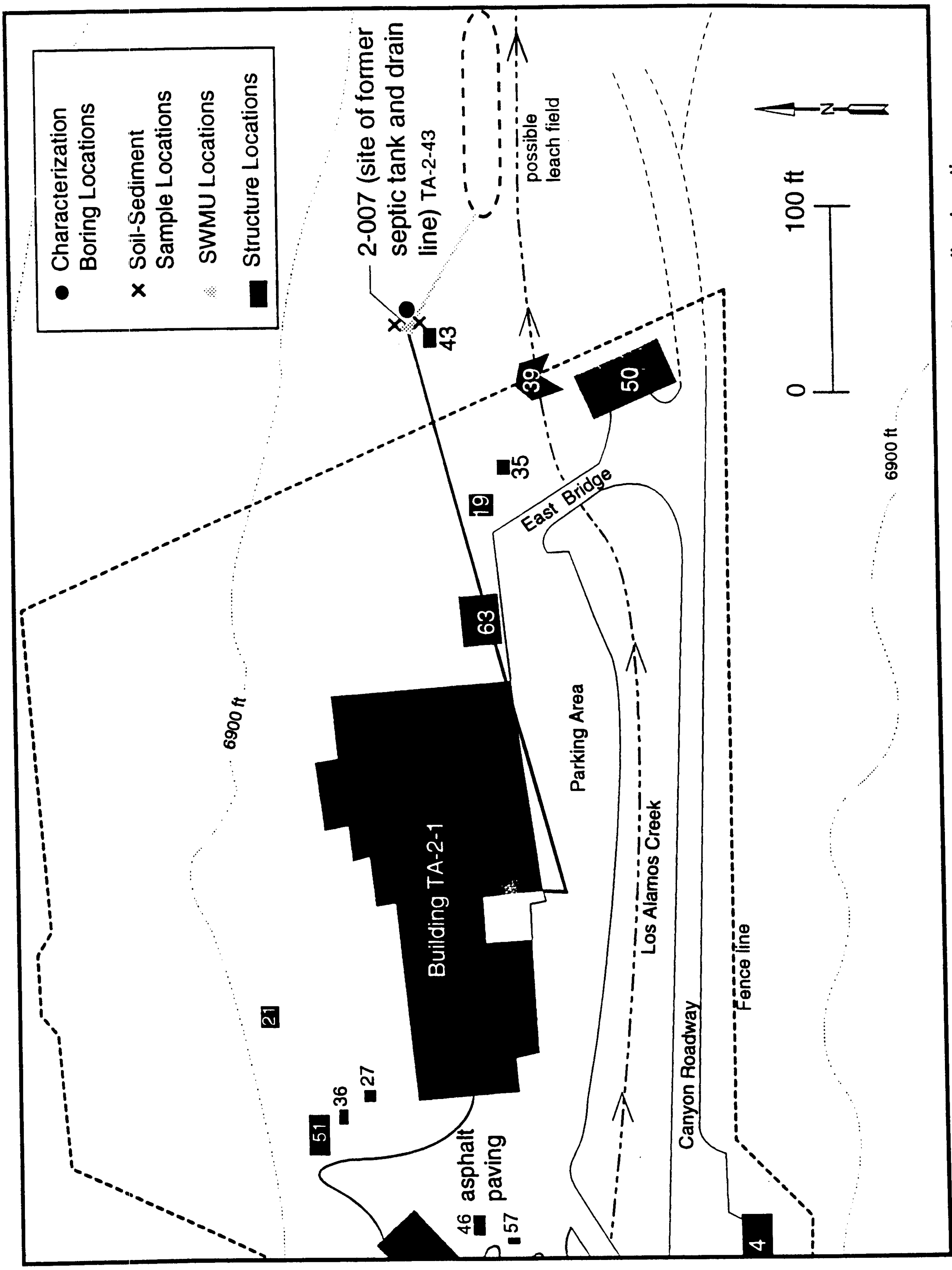


Figure 7.8-1 Proposed SWMU no. 2-007, decommissioned septic system, RFI boring-soil sampling locations.

basement and the septic tank was rerouted by teeing off a 6-in. PVC pipe from a location near TA-2-43 directly to the stream a few feet downstream of the concrete debris catcher (TA-2-39) (Elder and Knoell 1986, 14-0014). This pipe is addressed separately as SWMU 2-007(c). The soil around the TA-2-43 outfall showed radioactivity of approximately 2000 - 4000 pCi/g detected over an area 83 by 22 ft. At its nearest point, the stream was about 10 ft away. Soil was removed down to groundwater level where samples showed 74 pCi/g beta/gamma and 68 pCi/g alpha activities. These samples were taken 6 to 8 ft below the original grade. The area was then backfilled with 6 to 8 ft of clean tuff (Elder and Knoell 1986, 14-0014).

The SWMU report indicates that the tank may have received industrial liquids in addition to sanitary wastes. Other than obvious radioactive contamination, it is not known if other types of hazardous industrial pollutants have been discharged into the tank.

7.8.2 Sampling Objectives and Potential Contaminants

Previous decontamination and decommissioning (D&D) activities of the Water Boiler reactor have removed the septic tank and its drain line, along with some of the potential contaminants of concern (COCs) within surrounding soils. The presence or absence of contaminants associated with the former site of the septic tank will be investigated during Phase I activities for SWMU 2-007, which will determine if this SWMU unit can be recommended for no further action (NFA) or if it should undergo voluntary corrective action (VCA) or Phase II investigation. Sampling to assess residual contamination of the leachfield east of the septic tank will be addressed in SWMU 2-009(c)ii.

Based on the history of TA-2, contaminants which may be present in the SWMU vicinity due to reactor operations include gross alpha/beta, cesium-137, strontium-90, technetium-99, cobalt-60, tritium, uranium, isotopic plutonium, chromium, and mercury. Soil and sediment samples collected for this SWMU will be analyzed for these constituents. In addition, this septic tank is likely to have received industrial liquids from the chemical waste shack (SWMU 2-010) and sanitary wastes. Therefore, all samples will also be analyzed for inorganics and semivolatiles, in addition to the standard analyte list for TA-2 (see Section 7.1) as summarized in Table 7.8-1.

TABLE 7.8-1
POTENTIAL CONTAMINANTS FOR
SWMU 2-007

Potential Contaminant	Level III Method
Gross alpha/beta	Gas flow proportional counter
Gross gamma	Gamma spectrometry
Cesium-137	Gamma spectrometry
Strontium-90	Gas flow proportional counter
Technetium-99	Gamma spectrometry
Uranium (total)	ICP
Plutonium (isotopic)	Radiochemical separation and alpha spectrometry
Cobalt-60	Gamma spectrometry
Tritium	Distillation and liquid scintillation
Mercury	EPA Method 7470, Cold Vapor
Inorganics (includes chromium)	EPA Method 6010, ICP
Semivolatile organics	EPA Method 8270

7.8.3 SWMU No. 2-007 Sampling Plan

Phase I activities for SWMU 2-007 will include an engineering survey, radiological survey, surface soil/sediment sampling, and subsurface sampling. These activities will be performed following LANL Standard Operating Procedures, as listed in Table 7.3-1. The total number of samples to be collected for SWMU 2-007 is summarized in Table 7.8-2.

TABLE 7.8-2
SUMMARY OF SAMPLES FOR OU 1098 PHASE I
BASELINE CHARACTERIZATION - SWMU 2-007

	Number of Samples	
	Soil/Sediment	Subsurface Soil*
Analytical samples	2	3
QA samples		
Rinsate blank	0	1
Field duplicate	0	1
Field blank**	0	1
Total number of samples	2	6

**An average of three soil samples will be collected per borehole.*
***Field blank submitted for inorganics, mercury, and semivolatiles only.*

7.8.3.1 Engineering and Radiological Surveys

An engineering survey will be performed to locate the former location of the septic tank, its outfall, and the leachfield. These data will be recorded on base maps of the area.

A walkover radiation survey will be conducted at the former site of the septic tank to identify potential radiological anomalies, and will continue until detectors reveal no additional contaminant locations. Locations of elevated radioactivity, defined as greater than two standard deviations from the mean radiation level detected in the vicinity of TA-2, will be flagged and recorded in the field log with corresponding activities. At these locations, soil/sediment samples will be collected for mobile field lab measurement of gross alpha, beta, and gamma radiation. If point sources are identified on a case by case basis during these surveys, VCAs to remove point sources and subsequent surface sampling may be implemented, if permitted.

7.8.3.2 Surface Sampling

Surface soil and sediment samples will be collected, as shown in Figure 7.8-1, at the former site of the septic tank. This tank was removed during D&D activities, leaving disturbed soil in the area which may potentially be contaminated and which can be sampled via surface sampling. Two surface samples will be collected at a depth of 0 to 12 in. Sampling locations will be moved to areas of radiological anomalies, as defined above, if detected.

Any contaminated material at or near the surface will be treated as a potential source of contamination. Therefore, when feasible, such near-surface material debris will be removed as a VCA. Soil samples that are in contact with any contaminated material will be characterized.

7.8.3.3 Subsurface Sampling

Subsurface soil samples will be collected from one boring at the former septic tank site, as shown on Figure 7.8-1. These samples will be collected to confirm presence or absence of potential contaminants of concern. The boring location will be moved to a location of a radiological anomaly, as defined above, if detected.

A hollow-stem auger or other suitable technique will be used to drill the characterization boring to a minimum depth of 15 ft to determine if subsurface soils have been contaminated. A 5-ft-long split-barrel core sampler will be used to collect continuous soil/rock samples in 5-ft intervals. When the core sample is retrieved, it will be screened along its entire length for radiation. At the site of the former septic tank, one sample will be collected at a depth of 0 to 12 in. One to three samples will be collected from the remaining depth of the boring, with at least one taken from the section of core with the highest observed radioactivity. If no anomalous radioactivity is detected, the samples will be collected based on lithology and visual observations. The exact depth of each sample collected will be recorded in the field log. Drilling may be continued to a depth greater than 15 ft at each boring location if field screening determines that two consecutive core intervals show anomalous radioactivity, as defined in section 7.8.3.1.

7.8.4 Sample Screening and Analysis

All sample packages will be screened for radiation using an alpha scintillometer, micro R meter, and pancake GM counter prior to shipment to the laboratory for analysis. Table 7.8-3 summarizes the number of samples to be analyzed for each specified method of analysis in Table 7.8-1 for SWMU 2-007 samples. Present screening action levels, practical quantitation limits, analytical methods, and required sample size for each analyte are presented in Table 5.1 in the Quality Assurance Project Plan for OU 1098 (Annex II of this work plan).

TABLE 7.8-3
SUMMARY OF ANALYSES FOR OU 1098
PHASE I CHARACTERIZATION - SWMU 2-007

Level III Method	Number of analyses	
	Surface Soil/sediment	Subsurface Soil
Gas flow proportional counter	2	5
Gamma spectrometry	2	5
Radiochemical separation and alpha spectrometry	2	5
Distillation and liquid scintillation ICP	2	5
EPA Method 6010	2	6
EPA Method 7470, Cold Vapor	2	6
EPA Method 8270	2	6

7.9 SWMU 2-008, DESCRIPTION OF OUTFALLS

7.9.1 Site Description and History

SWMU 2-008 consists of three subparts [(a) through (c)] (Figure 7.9-1):

1. The SWMU report indicates that 2-008(a) is an outfall from the cooling tower blowdown. This outfall has discharged secondary cooling water from the cooling tower since its construction in 1957. Until the mid-1970s, potassium dichromate was routinely added to the secondary cooling water to prevent corrosion of aluminum heat exchangers in the tower (Neely 1992, 14-0008). Most of the potassium dichromate would adhere onto the aluminum heat exchangers, creating a protective seal; however, some hexavalent chromium was discharged continuously in water out of this outfall. In the mid-1970s, the aluminum heat exchangers were replaced with stainless steel heat exchangers, and the use of potassium dichromate was discontinued. Currently this outfall is NPDES permitted (serial no. 020).
2. SWMU 2-008(b) is an outfall from building TA-2-4, which had a photo processing facility (DOE 1987, 0264). The exact location of this outfall is unknown at this time. This outfall has been inactive for at least 10 yrs, according to the SWMU report. Solutions containing hazardous chemicals from the photo processing facility are likely to have been discharged through this outfall, although specific amounts are unknown at this time. There is not a current National Pollutant Discharge Elimination System (NPDES) permit for this outfall.
3. SWMU 2-008(c) is an outfall that discharges directly to the stream a few feet downstream from the concrete debris catcher (TA-2-39) (DOE 1987, 0264) east of building TA-2-1. During the Phase I decommissioning effort at TA-2 in 1985 and 1986, a 6-in. clay pipe from the basement of building TA-2-1 was disconnected from the septic tank being removed (TA-2-43) and joined to a 6 in. PVC pipe which discharged to the creek. The SWMU report indicates this PVC pipe was connected to a sump; however, this structure is not found on engineering drawings. This line became plugged in 1988 and was abandoned in place. A new line was installed, possibly from the sump, just to the west of the East Bridge. Spring water that infiltrated the basement of building TA-2-1 was reportedly discharged through this outfall. There is no indication that there have been any additional wastes included in the discharge through this outfall. A NPDES permit application was issued for the outfall when the new line was installed to the west of the East Bridge.

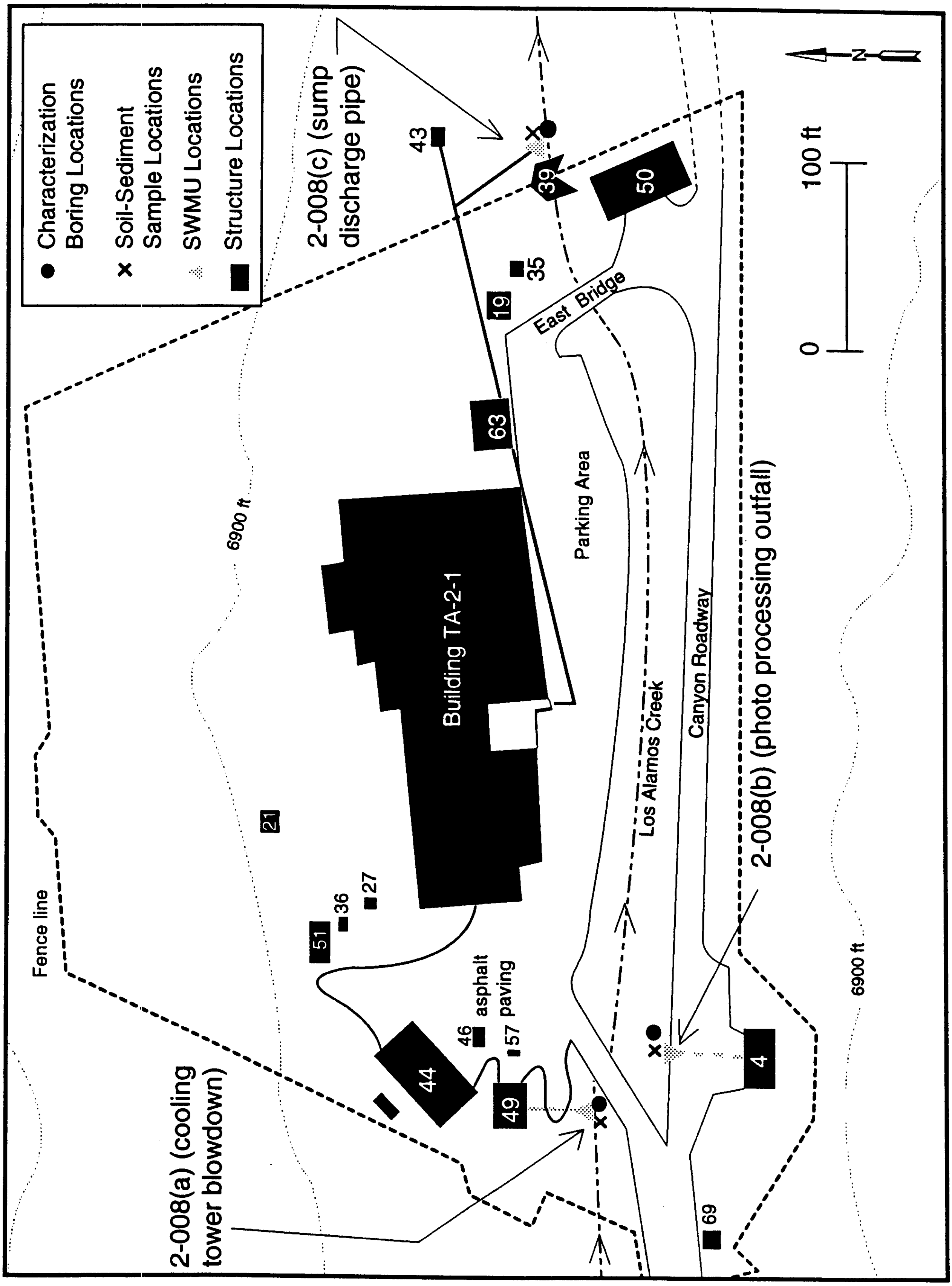


Figure 7.9-1 Proposed SWMU no. 2-008, outfalls, RFI boring-soil sampling locations.

7.9.2 Sampling Objectives and Potential Contaminants

The main potential contaminant for SWMU 2-008(a) is chromium discharged from cooling water. In addition, fission products (gross alpha/beta, tritium, and cobalt-60) from the Omega West Reactor (OWR) are potential contaminants if primary coolant reactor water leaked into secondary cooling water via a breach in the heat exchangers. (See Section 7.5.1 for a description of the cooling water process.) Although such a breach is unlikely, it is prudent to sample for all of these and other potential TA-2 contaminants to confirm their absence in the outfall of 2-008(a).

The exact potential COCs for SWMU 2-008(b), an outfall from a photo processing facility, are unknown except for silver. Therefore, the surface sample from this outfall will be sampled for Appendix IX constituents (inorganics, semi-volatile organics, volatile organics, and organochlorine pesticides) to detect any possible chemicals which may have been discharged to this outfall. Additionally, this sample will serve as another point for baseline characterization of the creek bed, as discussed in section 7.1. Surface and subsurface samples will also be analyzed for OWR tritium and fission products (gross alpha/beta and cobalt-60) and chromium (included with the Appendix IX analysis) as well as the other potential TA-2 contaminants (Section 7.1) to provide an additional confirmation of presence or absence of potential contaminants in creek bed sediments from OWR operations.

Potential COCs for outfall 2-008(c) include tritium and fission products (gross alpha/beta, and cobalt-60) from OWR operations and chromium. The main discharge through this outfall is spring water which infiltrates the basement of TA-2-1 and is pumped out via this drainline and outfall. Since building TA-2-1 has housed several reactors, the potential for contamination of infiltrating groundwater should be addressed. Since this outfall is downstream from most TA-2 structures, the samples collected here should also be analyzed for fission products associated with the Water Boiler reactor (cesium-137, strontium-90, technetium-99, and total uranium) and the Clementine reactor (isotopic plutonium and mercury), as well as the other potential TA-2 contaminants (Section 7.1).

Table 7.9-1 summarizes the constituents which will be analyzed in samples collected for SWMU 2-008(a), (b), and (c).

TABLE 7.9-1
POTENTIAL CONTAMINANTS FOR
SWMU 2-008

Potential Contaminant	Level III Method
Gross alpha/beta	Gas flow proportional counter
Gross gamma	Gamma spectrometry
Cesium-137	Gamma spectrometry
Strontium-90	Gas flow proportional counter
Technetium-99	Gamma spectrometry
Uranium (total)	ICP
Plutonium (isotopic)	Radiochemical separation and alpha spectrometry
Cobalt-60	Gamma spectrometry
Tritium	Distillation and liquid scintillation
Mercury	EPA Method 7470, Cold Vapor
Inorganics (includes chromium)	EPA Method 6010, ICP
Semivolatile organics	EPA Method 8270
Volatile organics	EPA Method 8240
Organochlorine pesticides	EPA Method 8080

7.9.3 SWMU No. 2-008 Sampling Plan

Phase I activities for SWMU 2-008 will include an engineering survey, radiological survey, surface soil/sediment sampling, subsurface sampling, and possibly sampling of a sump. These activities will be performed following LANL Standard Operating Procedures, as listed in Table 7.3-1. The total number of samples to be collected for SWMU 2-008 is summarized in Table 7.9-2.

TABLE 7.9-2
SUMMARY OF SAMPLES FOR OU 1098
PHASE I CHARACTERIZATION - SWMU 2-008

	Number of Samples		
	Soil/Sediment	Subsurface Soil*	Sump
Analytical samples	3**	9**	(2)**
QA samples			
Rinsate blank	0	1	0
Field duplicate	0	1	0
Field blank***	0	1	0
Trip blank	0	1	0
Total number of samples	3**	12**	(2)**

* *An average of three soil samples will be collected per borehole*
** *Two samples will be taken of the sump, if found, and the number of surface analytical samples will be reduced by 1 and subsurface samples by 3.*
*** *Field blanks will be submitted for non-radiological analyses only.*

7.9.3.1 Engineering and Radiological Surveys

An engineering survey will be performed to locate SWMU units 2-008(a), (b), and (c). These data will be recorded on base maps of the area.

A walkover radiation survey will be conducted to at least 5 ft of the outfall of each SWMU to identify potential radiological anomalies, and will continue until detectors reveal no additional contaminant locations. Locations of elevated radioactivity, defined as greater than two standard deviations from the mean radiation level detected in the vicinity of TA-2, will be flagged and recorded in the field log with corresponding activities. At these locations, soil/sediment samples will be collected for mobile field lab measurement of gross alpha, beta, and gamma radiation. If point sources are identified on a case by case basis during these surveys, voluntary corrective actions (VCAs) to remove point sources and subsequent surface sampling may be implemented, if permitted.

7.9.3.2 Surface Sampling

Surface soil and sediment samples will be collected as shown on Figure 7.9-1 to a depth of 0 to 12 in. A total of three surface samples will be collected, one from each SWMU subunit outfall. The locations of these samples will be moved to areas of radiological anomalies, as defined above. The surface sample for SWMU 2-008(c) will be moved to the sump if this structure is found in the field, as described in Section 7.9.3.4.

Any contaminated material on or near the surface will be treated as a potential source of contamination. Therefore, when feasible, such near-surface contaminated material will be removed as a VCA. Soil samples that are in contact with any contaminated material will be characterized.

7.9.3.3 Subsurface Sampling

Subsurface soil samples will be collected from three borings, one at each of the outfalls of SWMU 2-008, as shown on Figure 7.9-1. These samples will be collected to confirm the presence or absence of potential COCs at depth in the creek bed. The boring locations will be moved to locations of radiological anomalies, as defined above, if detected. The boring for the outfall of 2-008(c) will be moved to a sludge/sediment sample of the sump if the sump is found to exist in field investigations.

A hollow-stem auger or other suitable technique will be used to drill the characterization borings to a minimum depth of 15 ft to determine if subsurface soils have been contaminated. A 5-ft-long split-barrel core sampler will be used to collect continuous soil/rock samples in 5-ft intervals. When the core sample is retrieved, it will be screened along its entire length for radiation. One sample will be collected from each boring at a depth of 0 to 12 in. One to three samples will be collected from the remaining depth of each boring, with at least one taken from the section of core with the highest observed radioactivity. If no anomalous radioactivity is detected, the samples will be collected based on lithology and visual observations. The exact depth of each sample collected will be recorded in the field log. Drilling may be continued to a depth greater than 15 ft if field screening determines that two consecutive core intervals show anomalous radioactivity, as defined in section 7.9.3.1.

7.9.3.4 Sump Sampling

It is unknown if the sump associated with SWMU 2-008(c) exists. If the sump is found to exist at the time of field investigation, the sampling planned for the outfall of 2-008(c) will be included on two additional samples taken at the sump sludge/sediment in conjunction with the surface and borehole samples. If contamination is present due to infiltration of water in the basement of TA-2-1 and subsequent pumping through this sump, it is most likely to be detected in the sludge/sediment in the bottom of the sump.

7.9.4 Sample Screening and Analysis

All sample packages will be screened for radiation using an alpha scintillometer, micro R meter, and pancake GM counter prior to shipment to the laboratory for analysis. Table 7.9-3 summarizes the number of samples to be analyzed for each specified method of analysis in Table 7.9-1 for SWMU 2-008 samples. Present screening action levels, practical quantization limits, analytical methods, and required sample size for each analyte is presented in Table 5.1 in the Quality Assurance Project Plan for OU 1098 (Annex II of this work plan).

TABLE 7.9-3
SUMMARY OF ANALYSES FOR OU 1098
PHASE I CHARACTERIZATION - SWMU 2-008

Level III Method	Number of analyses		
	Surface Soil/sediment	Subsurface Soil	Sump/ Dry Well*
Gas flow proportional counter	3	11	(2)
Gamma spectrometry	3	11	(2)
Radiochemical separation and alpha spectrometry	3	11	(2)
Distillation and liquid scintillation	3	11	(2)
EPA Method 6010, ICP	3	12	(2)
EPA Method 7470, Cold Vapor	3	12	(2)
EPA Method 8270**	1	0	0
EPA Method 8240**	1	0	0
EPA Method 8080 **	1	0	0

** Two samples will be taken of the sump, if found, and the total number of surface samples will be reduced by 1 and subsurface samples by 3.*
*** Semivolatiles, volatiles, and organochlorine pesticides are to be analyzed only for surface samples collected for SWMU 2-008 (b).*

7.10 SWMU NO. 2-009, OPERATIONAL RELEASES

7.10.1 Site Description and History

In 1985 and 1986, several of the structures associated with past operations at TA-2 were decommissioned. While the structures were being removed, radioactivity was detected above background levels in several areas (Elder and Knoell 1986, 14-0014). Most of the contaminated soil was removed and taken to the radioactive waste disposal area at TA-54. However, residual radioactivity remained in some areas after decontamination operations discontinued. These areas of residual radioactivity are shown in Figure 7.10-1 and are described below.

The subsurface low-level residual radioactivity at each SWMU subunit is due to small amounts of radionuclides present in the soil. As far as is known, sampling for nonradioactive contamination was not undertaken. Radionuclides are present in the vegetation near building TA-2-1 (Figure 7.10-2). It is not known whether mobilization from these small areas of residual contamination has occurred.

SWMU no. 2-009(a) was associated with a previous water boiler reactor and was identified during the 1986 operations that included the decontamination of two local hot spots behind (south and east of) TA-2-50 (Elder and Knoell 1986, 14-0014) (Figure 7.10-1). The first spot was approximately 15 m east and 10 m south of the fence corner behind TA-2-50, near the downhill face of a large boulder; the second spot was located approximately 130 m east of the fence corner. Both of these areas were decontaminated to background concentrations; however, surveys conducted uphill from the boulder detected other contamination as high as 273 pCi/g. Lack of funds prevented this contamination from being removed when it was discovered. Investigation during Phase I for SWMU no. 2-009(a) will concentrate on this area of residual contamination uphill of the boulder.

SWMU no. 2-009(b) consists of residual contamination in the area near the bridge which served as a truck staging area during decommissioning operations (1985–1986) and in the area north of the TA-2-19 location. The temporary truck staging area showed minor positive activity (average 30 pCi/g) prior to the application of 6 in. of topsoil. Several contaminated items were removed from the area north of the TA-2-19 location; however, local minor contamination remains in the area. This area was not addressed further because of its location inside the TA-2 security fence.

SWMU 2-009(c) comprises two areas near to and/or associated with the TA-2-48 location. The first area, 2-009(c)i, is an area around the former site of TA-2-48, a condensing trap for the gaseous effluent stack line, and consists of the sites occupied by the primary pit (north of the stream) and the secondary pit (south of the stream) that were used when TA-2-48 was being removed. To remove the underground components of TA-2-48, workers excavated a primary pit at the site. However, infiltrating groundwater and contaminated soil prevented removal of the components. It then became necessary to pump infiltrating groundwater from the TA-2-48 excavation to a secondary pit.

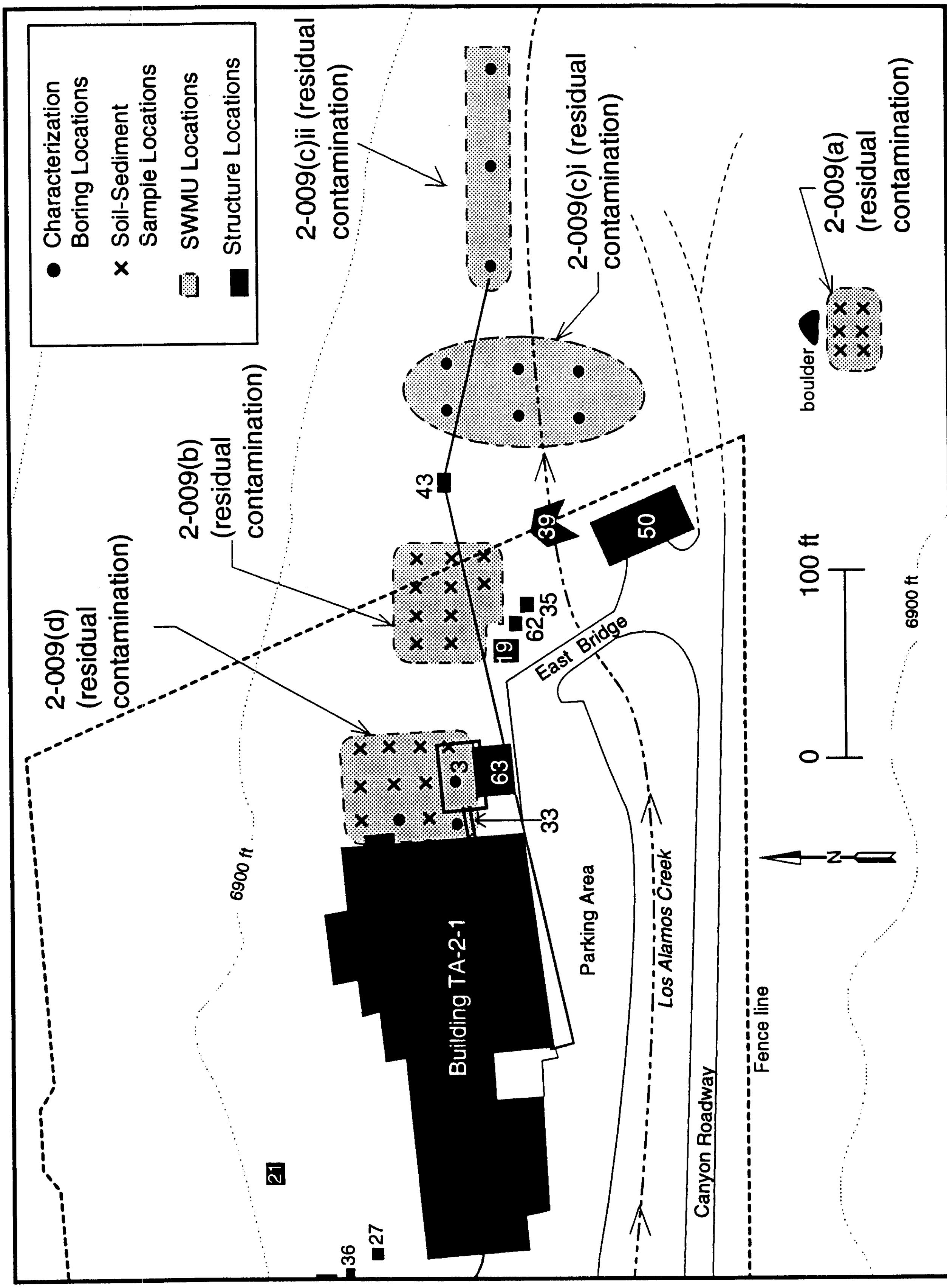


Figure 7.10-1 Proposed SWMU no. 2-009, operational releases, RFI boring-soil sampling locations.

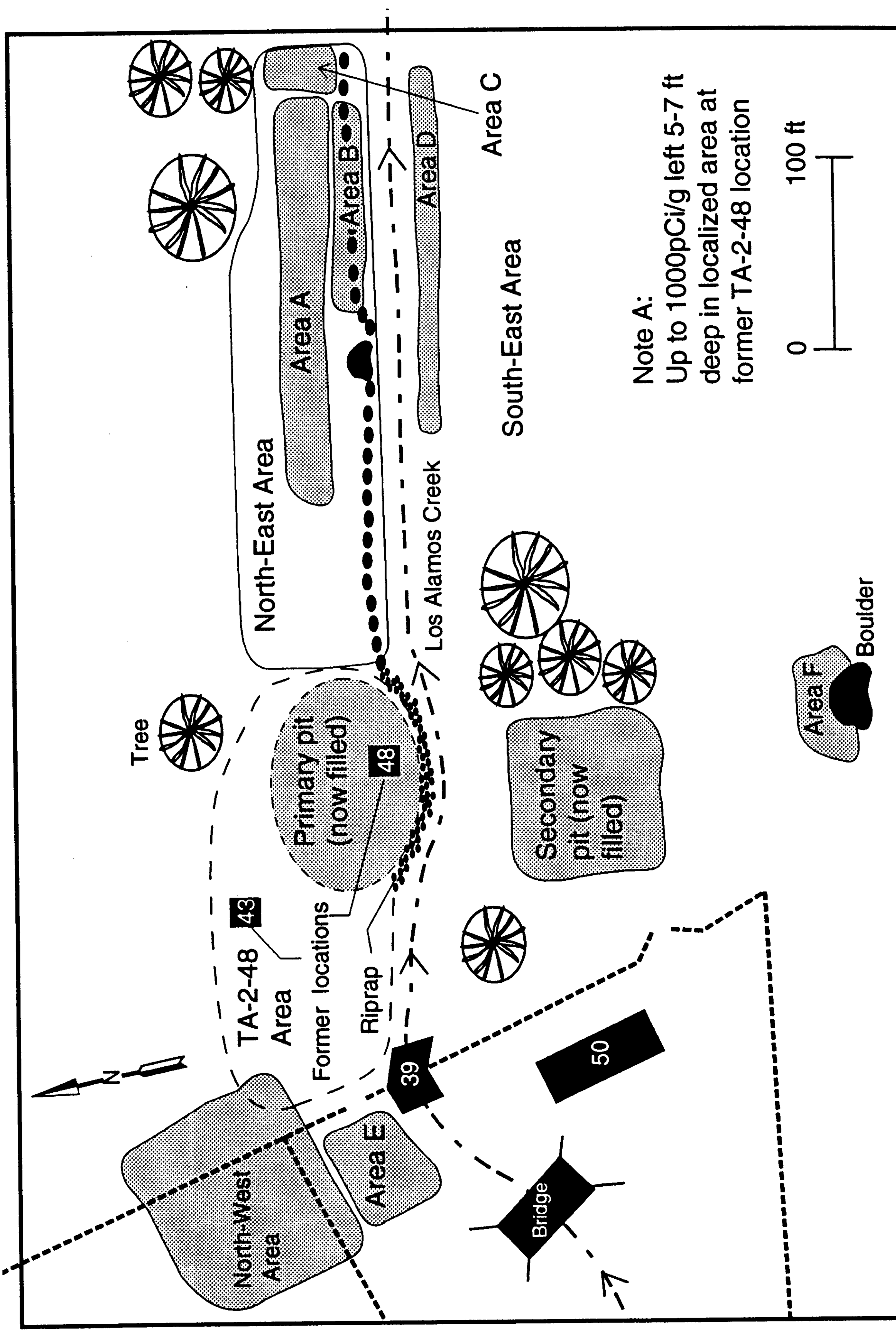


Figure 7.10-2 Areas where surface radioactive contamination was removed (Elder and Knoell 1986, 14-0014).

When all of TA-2-48 had been removed, the final cesium-137 activity in the soil of the primary pit was 1000 pCi/g left at a depth greater than 5 ft (much of the area was left under 7 ft of clean fill).

Another area east of the TA-2-48 location was found to be contaminated [SWMU 2-009(c)ii]. During the Phase I decommissioning of the Water Boiler Reactor at TA-2 in 1985, two contaminated lengths of 6-in. vitrified clay pipe (54 ft total length) were uncovered below the route of the TA-2-43 septic tank drain pipe (see SWMU no. 2-007). These pipes are located in area A of Figure 7.10-2. The arrangement of rock, sand, and pipe indicated that a leach field may have existed when the Water Boiler Reactor was present. A veteran operator of TA-2 recalled that the chemical waste-treatment shack located east of the reactor building might have been a possible source of the material that was disposed of in the leach field (Elder and Knoell 1986, 14-0014). It is likely that the leach field originates from septic tank TA-2-43, which had an effluent pipe located in this area. This septic tank was known to be contaminated (see SWMU 2-007 description) and the chemical waste shack was connected to this system. The contamination in the pipe segments was a mixture of alpha, beta, and gamma emitters, uranium-235 being the primary alpha emitter (Elder and Knoell 1986, 14-0014). The pipe segments were probably the remnants of an earlier removal operation. Initial activity at this location was 2000-4000 pCi/g detected over an area 83 by 22 ft. At its nearest point, the stream was about 10 ft away from the pipe segments. After the soil had been removed down to groundwater level, the remaining concentrations of beta/gamma emitters were measured at 53–67 pCi/g, with no alpha radioactivity above detection limits. These samples were taken 6–8 ft below the original grade. The area was backfilled with clean tuff (Elder and Knoell 1986, 14-0014).

SWMU no. 2-009(d) is reported to be an additional area of known radioactivity contamination located near the east end of building TA-2-1 (Figure 7.10-1). It is unclear whether this contamination is associated with TA-2-3, the chemical shack (SWMU 2-010), a previous storage area consisting of drums containing kerosene, acetone, and trichloroethylene (Neely 1992, 14-0008), or some other source. Vegetation from a tree in this area was analyzed and found to be radioactive (Neely, 1992, 14-0008).

7.10.2 Sampling Objectives and Potential Contaminants

Previous decontamination and decommissioning activities of the Water Boiler reactor and chemical waste shack have left four areas of suspected residual contamination, SWMU 2-009(a) through (d). Phase I activities, in addition to confirming the presence or absence of contamination, are intended to determine the extent of contamination in support of a possible VCA or eventual CMS, and to estimate the average level of contamination in support of an eventual baseline risk assessment.

The investigation of SWMU 2-009(d) will include an assessment of residual contamination due to the chemical waste shack, SWMU 2-010 (see Section 7.11) and the investigation of SWMU 2-009(c)ii will include an assessment of residual contamination due to the septic tank, SWMU 2-007.

Based on the history of TA-2, the contaminants likely to be present at all of the

SWMU subunits, due to reactor operations, include cesium-137, strontium-90, technetium-99, cobalt-60, tritium, uranium, isotopic plutonium, chromium, and mercury. Soil and sediment samples collected in all SWMU subunits will be analyzed for these constituents, in addition to the remainder of TA-2 potential COCs (see section 7.1) as summarized in Table 7.10-1. SWMU 2-009(d) is an area where drums containing organic constituents were stored, and is the site of a former chemical waste shack. SWMU 2-009(c)ii is a former leachfield for a septic tank which received wastes from laboratories and the chemical waste shack. Therefore samples collected in these areas will also be analyzed for inorganics and semivolatile organics.

TABLE 7.10-1
POTENTIAL CONTAMINANTS FOR
SWMU 2-009

Potential Contaminant	Level III Method
Gross alpha/beta	Gas flow proportional counter
Gross gamma	Gamma spectrometry
Cesium-137	Gamma spectrometry
Strontium-90	Gas flow proportional counter
Technetium-99	Gamma spectrometry
Uranium (total)	ICP
Plutonium (isotopic)	Radiochemical separation and alpha spectrometry
Cobalt-60	Gamma spectrometry
Tritium	Distillation and liquid scintillation
Chromium (total)	EPA Method 6010, Atomic Absorption
Mercury	EPA Method 7470, Cold Vapor
Inorganics	EPA Method 6010, ICP
Semivolatile organics	EPA Method 8270

7.10.3 SWMU No. 2-009 Sampling Plan

Phase I activities for SWMU 2-009 will include an engineering survey, radiological survey, surface soil/sediment sampling, and subsurface sampling. These activities will be performed following LANL Standard Operating Procedures, as listed in Table 7.3-1. The total number of samples to be collected for SWMU 2-009 is summarized in Table 7.10-2.

TABLE 7.10-2
SUMMARY OF SAMPLES FOR OU 1098
PHASE I CHARACTERIZATION-SWMU 2-009

	Number of Samples Soil/Sediment	Subsurface Soil*
Analytical samples	25	36
QA samples		
Rinsate blank	1	2
Field duplicate	1`	2
Field blank**	1	2
Total number of samples	28	42

*An average of three subsurface soil samples will be collected per borehole.
**Field blanks will be submitted for non-radiological analyses only.

7.10.3.1 Engineering and Radiological Surveys

An engineering survey will be performed to locate the former location of the drum storage area and the chemical waste shack, and to locate the present locations of the areas of residual contamination. This data will be recorded on base maps of the area.

A walkover radiation survey will be conducted at SWMU 2-009(a) and (d) to identify potential radiological anomalies, and will continue until detectors reveal no additional contaminant locations. Locations of elevated radioactivity, defined as greater than two standard deviations from the mean radiation level detected in the vicinity of TA-2, will be flagged and recorded in the field log with corresponding activities. At these locations, soil/sediment samples will be collected for mobile field lab measurement of gross alpha, beta, and gamma radiation. If point sources are identified, on a case by case basis, during these surveys, voluntary corrective actions (VCAs) to remove point sources and subsequent surface sampling may be implemented, if permitted.

SWMU 2-009(c)ii will be field screened for volatile organics to locate areas potentially contaminated with organics. Core samples collected for SWMU 2-009(c)ii and 2-009(d) will also be screened for volatile organics to help collect most contaminated core samples.

7.10.3.2 Surface Sampling

Surface soil and sediment samples will be collected, as shown in Figure 7.10-1, at SWMU 2-009(a), (b), and (d). Samples at 2-009(a) and (d) will be collected at a depth of 0 to 12 in., and samples at 2-009(b) will be collected at a depth of 0 to 18 in. A total of 25 surface samples will be collected from these areas. The number of samples to be collected at each site were chosen based on recommendations presented in Appendix H (Statistical Sampling and Data Analysis for Environmental Restoration) of the IWP. Reconnaissance sampling was chosen as the most appropriate sampling approach for these areas, to address the question of whether contamination is present above screening action levels. Six samples will be collected at SWMU 2-009(a), reflecting an estimated fraction of contaminated area around 45 percent, and a required confidence level of 95 percent. Ten samples will be collected at SWMU 2-009(b), reflecting an estimated fraction of contaminated area around 30 percent and a 95 percent confidence level. At 2-009(d), a total of twelve samples will be collected (nine of which are surface samples and three of which are borings in which surface samples will be collected), reflecting an estimated fraction of contaminated area around 25 percent and a 95 percent confidence level. Sampling locations are in roughly 20 ft grid spacings. However, to ensure the detection of contamination in surface soils and sediments, sampling locations will be moved to areas of radiological anomalies, or organic vapor anomalies as defined above, or to areas of suspect nature (i.e. soil staining).

Any contaminated material on or near the surface will be treated as a potential source of contamination. Therefore, when feasible, such near-surface contaminated materials will be removed as a VCA. Soil samples that are in contact with any contaminated material will be characterized.

7.10.3.3 Subsurface Sampling

Subsurface soil samples will be collected from a total of twelve boreholes at SWMU 2-009(c)i and ii and (d), as shown in Figure 7.10-1. At SWMU 2-009(d) one borehole will be placed adjacent to the former drum storage area and two will be placed beneath the location of the former chemical shack. Samples collected from these boreholes will assess presence or absence of contamination at depth due to possible leakage of constituents from the storage area, and possible leakage from underground piping suspected of carrying contaminants from the chemical waste shack. Boring locations will be moved to areas of radiological anomalies, as defined above, if detected.

At SWMU 2-009(c) the presence of residual contamination from D&D activities is documented. Therefore, six borings will be placed, as shown in Figure 7.10-1, to assess the extent of residual contamination in this area. The depth of contamination will also be assessed with these borings. At SWMU 2-009(c)ii, the exact location of contamination is not well known. Therefore three borings will be done in the area of the leachfield to detect any residual contamination.

A hollow-stem auger or other suitable method will be used to drill the characterization borings to a minimum depth of 15 ft to determine if subsurface soils have been contaminated. A 5-ft-long split-barrel core sampler will be used to collect continuous soil/rock samples in 5-ft intervals. When the core sample is retrieved, it will be screened along its entire length for radiation and organic vapors. One sample will be collected at a depth of 0 to 12 in. from each boring from 2-009(d). One to three samples will be collected from the remaining depth of each boring at 2-009(d), with at least one taken from the section of core with the highest field-observed radioactivity or organic vapor activity. For borings at 2-009(c)i and ii, two to four samples will be collected below the level of fill (5 to 8 ft.) with at least one from the section of core with the highest observed radioactivity or organic vapor activity. If no anomalous activity is detected, the samples will be collected based on lithology and visual observations. The exact depth of each sample collected will be recorded in the field log. Drilling may be continued to greater than 15 ft depth if field screening determines that two consecutive core intervals show anomalous radioactivity or organic vapor activity.

7.10.4 Sample Screening and Analysis

All sample packages will be screened for radiation, using an alpha scintillometer, micro R meter, and pancake GM counter, prior to shipment to the laboratory for analysis. Table 7.10-3 summarizes the number of samples to be analyzed for each specified method of analysis in Table 7.10-1 for SWMU 2-009 samples. Present screening action levels, practical quantitation limits, analytical methods, and required sample size for each analyte is presented in Table 5.1 in the Quality Assurance Project Plan for OU 1098 (Annex II).

TABLE 7.10-3
SUMMARY OF ANALYSES FOR OU 1098
PHASE I CHARACTERIZATION - SWMU 2-009

Level III Method	Number of analyses	
	Surface Soil/sediment	Subsurface Soil
Gas flow proportional counter	27	40
Gamma spectrometry	27	40
Radiochemical separation and alpha spectrometry	27	40
Distillation and liquid scintillation	27	40
EPA Method 6010, ICP	28	42
EPA Method 7470, Cold Vapor	28	42
EPA Method 8270*	12	24

* *Semivolatiles will be analyzed only for those samples collected for SWMUs 2-009(c)ii and 2-009(d).*

7.11 SWMU NO. 2-010, DESCRIPTION OF CHEMICAL SHACK WASTE UNITS

7.11.1 Site Description and History

A small chemical shack, building TA-2-3 (SWMU no. 2-010), was located to the east of the main reactor building (TA-2-1) at the site now occupied by the boiler house TA-2-63 (Figure 7.11-1). The chemical shack was removed in 1971 after portions of the structure were found to be radioactively contaminated (DOE 1987, 0264). The SWMU report describes two areas of residual contamination, which may be associated with the chemical waste shack. One area, located east of the former septic tank (TA-2-43) (Figure 7.11-1), is described in detail in SWMU 2-009(c)ii (Operational Releases). The other area, at the former site of the shack, is described below.

The chemical shack was constructed in 1944-1945 and contained hot cell measuring 6 ft by 7 ft by 20 ft in height, 4 ft 9 in. of which was below ground. The walls were 18 in. thick. The hot cell was used for reprocessing the uranyl nitrate reactor solution for the Water Boiler Reactor and for chemical studies on irradiated uranium-235. Before the shack was removed in 1971, the floor of the hot cell read 75 mR/h beta and gamma combined. A swipe indicating 5 mR/h was analyzed and cesium-137 was found. Contamination of 7500 counts/minute (c/m) alpha radiation was also found on the floor of the hot cell and more alpha contamination was expected in the plumbing inside of the hot cell. Outside the hot cell but within the chemical shack, a radiation survey was conducted. Walls and floors had been painted and the paint was thought to be shielding some alpha contamination. A chemical hood contained alpha, beta, and gamma contaminated items (a test tube holder showed 1500 c/m alpha). Lead bricks inside the hood showed 2000 c/m alpha and 20 mR/h beta and gamma. A sink in the chemical shack had 5 mR/hr beta, gamma contact with a drain under the sink. The contaminant was thought to be cesium-137 or other fission products. Because the drain was contaminated, the sewer was also expected to be contaminated (Neely 1971b, 14-0030).

Perchloric acid had been used in the hood system and other acids (not specified) were stored in the building (Neely 1971b, 14-0030).

A sewer line ran from TA-2-3 to the main sewer line from TA-2-1 (Figure 7.11-1). When the shack and sewer line were removed in 1971, the line read 20 mR/h beta/gamma (from cesium-137) and approximately 500 c/m alpha. The line was disconnected from the main sewer line and placed in wooden crates for contaminant disposal. A metal plaque was mounted on the main sewer line at the point where the sewer line from TA-2-3 had tied into it. The plaque noted the radiation level (10 mR/h), isotope, and date (Neely 1971b, 14-0030).

A pipe trench (TA-2-33), which ran from TA-2-3 to TA-2-1 (Figure 7.11-1), was abandoned in 1973. The SWMU report indicates that this pipe trench was found to be contaminated when the chemical shack was removed. However, according to the report by Neely (1971a, 14-0029), which describes in detail the

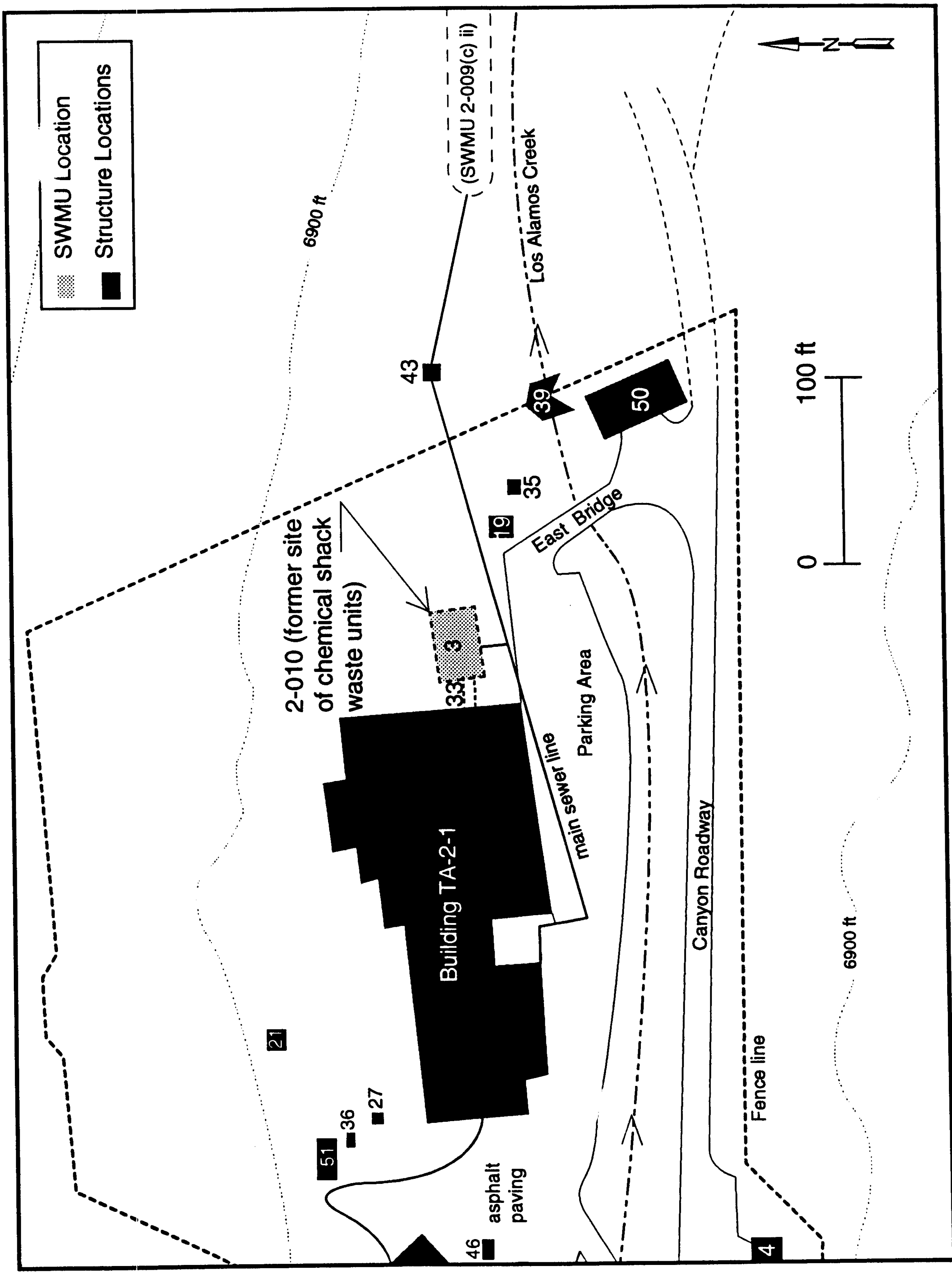


Figure 7.11-1 Proposed SWMU no. 2-010, chemical shack waste units.

removal of the shack, no alpha, beta, or gamma contamination was found. It is suspected that the SWMU report is referring to the sewer pipe running from TA-2-3 and not to the pipe trench (TA-2-33).

When the entire chemical shack and sewer line had been removed and the area cleared of vegetation, a survey was done of the surrounding soils. Maximum contamination due to cesium-137 was found to be 0.5 mR/h in the area under the former chemical shack and west of the TA-2-19 valve house (Figure 7.11-1). The contaminated dirt was removed from the site and taken to the disposal area for contaminated materials (TA-54). No estimate of the amount of dirt excavated was presented in the 1971b Neely document. A radiation survey was made of the site after the contaminated dirt had been removed and no alpha, beta, or gamma activity was detected by an E-112B or a 48A survey instrument. The main sewer line was the only contaminated item known to be left at the site. It is located at the north edge of the parking lot, next to TA-2-1 (Figure 7.11-1).

7.11.2 Sampling Objectives and Potential Contaminants

Site assessment at this SWMU has been preceded by a corrective action, which removed most contaminated equipment associated with the chemical shack waste units. The corrective action accomplished the following objectives:

- The areas were surveyed for radioactivity before, during, and after the removal procedure, and
- Most contaminated soils above the water table, as indicated by surveys or sampling, were excavated.

Phase I investigations will be conducted at SWMU 2-010 to determine whether residual contaminants of concern (COCs) still exist. In addition, sampling will be done for semivolatile organics, which was not done during the decontamination and decommissioning for this structure.

Sampling for this SWMU unit will be accomplished in conjunction with SWMU 2-009(d), an area of residual contamination immediately east of building TA-2-1. The sampling plan for this area is described in Section 7.10.

7.12 SWMU NO. 2-011, DESCRIPTION OF STORM DRAINS AND OUTFALLS

7.12.1 Site Description and History

SWMU 2-011 consists of five subparts [(a) through (e)] (Figure 7.12-1):

1. SWMU 2-011(a) consists of 11 drains associated with building TA-2-1:

i. A concrete storm drain northwest of TA-2-1 that drains into TA-2-36 (drop inlet), approximately 50 ft in length. There is no information that this drain handled anything but storm water.

ii. A 24-in. underground corrugated metal pipe (CMP) between TA-2-36 and TA-2-27 (drop inlet), approximately 8 ft in length. There is no information that this drain handled anything but storm water.

iii. A concrete storm drain northwest of TA-2-1 that drains into TA-2-27 (drop inlet), approximately 85 ft in length. Water from the fuel transfer pit was periodically emptied into this trench. Contaminated aluminum shards were commonly discharged with the water and settled into the drain (Neely 1992, 14-0008). This drain was cleaned out in 1970. Before these efforts, contamination as high 30 mR/h was measured in the trench (DOE 1987, 0264).

iv. A 15-in. concrete storm drain west of TA-2-1 that drains into TA-2-28 (surface inlet), approximately 15 ft in length. There is no information that this drain handled anything but storm water.

v. A 24-in. concrete storm drain between TA-2-27 and TA-2-28, approximately 10 ft in length. It is possible that this drain handled the fuel pit water coming from the concrete flume [2-011(a-iii)], with associated contaminated aluminum shards. Otherwise there is no information that this structure is contaminated.

vi. A 30-in. corrugated metal pipe (CMP) between TA-2-28 and the creek, approximately 30 ft in length. It is possible that this drain handled the fuel pit water coming from the concrete flume [2-011 (a-iii)], with associated contaminated aluminum shards. Otherwise there is no information that this structure is contaminated.

vii. A 6-in. pipe between TA-2-1 and TA-2-26 (the salvage basin), and the creek, approximately 18 ft in length. This structure is also addressed as SWMU 2-006(e), which is a drain in the floor and mezzanine of the OWR reactor room.

viii. An 18-in. CMP between the TA-2-1 catch basin and the creek, approximately 18 ft in length. There is no information that this drain handled anything but storm water.

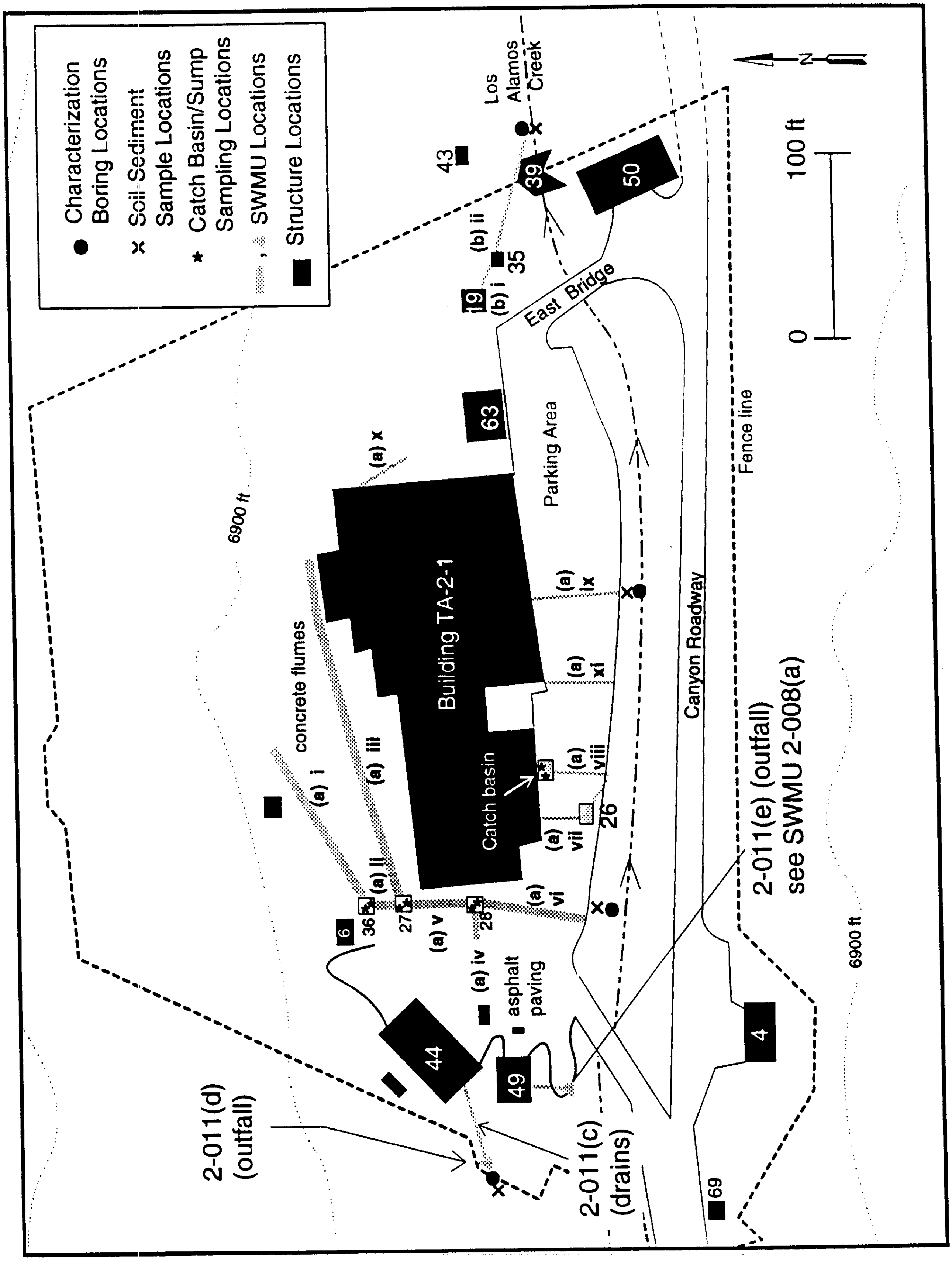


Figure 7.12-1 Proposed SWMU no. 2-011, storm drains and outfalls, RFI boring-soil sampling locations.

ix. A 3-in. pipe between TA-2-1 and the creek, approximately 25 ft in length. There is no information that this drain handled anything but storm water.

x. A 12-in. concrete drain northeast of TA-2-1 and discharging east of TA-2-1, approximately 12 ft in length. There is no information that this drain handled anything but storm water.

xi. A 4-in. pipe between TA-2-1 and the creek, approximately 13 ft in length. This pipe is likely an acid waste line which was abandoned 25 years ago. This pipe is addressed as SWMU 2-006(b).

2. SWMU 2-011(b) consists of two drains associated with structure TA-2-19, the stack gas valve house:

i. A 15-in. CMP between TA-2-19 and TA-2-35 (a drainage basin), approximately 9 ft in length.

ii. A 24-in. CMP from TA-2-35 that drains outside of the east fence, approximately 9 ft in length.

3. SWMU 2-011(c) consists of one drain associated with building TA-2-44 [SWMU 2-004(f)] (see Section 7.5). It is a 4-in. vitrified clay pipe (VCP) from TA-2-44 that drains outside of the west fence, approximately 12 ft in length. The outfall to this pipe is SWMU 2-011(d).

4. SWMU 2-011(d) is an outfall from TA-2-44. The outfall comes from a 4 in. vitrified clay pipe (VCP), approximately 12 ft in length [SWMU 2-011(c)]. This pipe and outfall are likely the route through which liquid effluent from an ion exchange system in TA-2-44 was discharged. This exchange system is described in SWMU 2-004(f). Primary cooling water would circulate through this exchange system to remove contaminants. Periodically, these ion exchangers would be regenerated by flushing clean city water through them. This flushed effluent water was discharged directly to the creek prior to 1963, most likely through this drain and outfall. From 1963 to 1968, this effluent water was held in three 1200-gal. storage tanks [SWMUs 2-004(b), (c), and (d)] until short-lived radioactive constituents decayed or were diluted to a safe level before being pumped into the creek. From 1968 to the present, these effluents were transferred to the three 1200-gal. storage tanks and then transported to TA-50 for proper disposal. Since then it appears that none of the ion exchange regenerate fluid has purposely been disposed of into the creek bed (Neely 1992, 14-0008).

   The regenerated effluent water's principal activity is the 15-hour-half life of sodium-24, with small amounts of chromium-51 (28 day), zinc-65 (244 day), and antimony-124 (60 day). Cobalt-60 (5.3 year) and manganese-56 (2.6 hour) have also been documented in regenerate effluent (Buckland 1967, 14-0038). During the 6-yr period from 1957 to 1963, a maximum rate of about 15 Ci/yr was released through effluent water discharging directly to the creek (Neely 1979, 14-0039). Periodic sampling during this time of the ground and creek water at monitoring points below the site showed no detectable increase in activity levels (Hankins 1971, 14-0028).

The SWMU report indicates that SWMU 2-011(d) is an NPDES permitted outfall (serial no. 019). However, this outfall does not currently discharge any controlled effluent, and is not currently NPDES permitted. Currently the only discharge through this outfall may be storm water, according to Engineering Drawing ENG-R391.

5. SWMU 2-011(e) is an outfall from TA-2-49, the cooling tower for the Omega West Reactor. This outfall has also been assigned as SWMU 2-008(a), cooling tower blowdown, and is addressed in Section 7.9.

7.12.2 Sampling Objectives and Potential Contaminants

Sampling for the numerous storm drains and outfalls at TA-2 will focus on areas most likely to accumulate contaminants. Therefore, structures such as catch basins and sediment below creek outfalls will be sampled to ascertain the presence or absence of potential contaminants of concern associated with the storm drains and outfall of SWMU 2-011.

Potential contaminants of concern for the drains and outfalls of 2-011(a), (c), and (d), including catch basins, are those constituents associated with OWR operations, including tritium, fission products (gross alpha/beta and cobalt-60), and chromium as well as other TA-2 potential contaminants (see Section 7.0). The drains of 2-011(b), which are at the east end of TA-2, also will have potential contaminants of concern from Water Boiler, and Clementine operations, which include tritium, cobalt-60, cesium-137, strontium-90, technetium-99, uranium, isotopic plutonium, mercury, and chromium, SWMU 2-011(e) is addressed as SWMU 2-008(a). Table 7.12-1 summarizes the constituents to be analyzed for samples collected from SWMUs 2-011(a) through (d).

TABLE 7.12-1
POTENTIAL CONTAMINANTS FOR
SWMU 2-011

Potential Contaminant	Level III Method
Gross alpha/beta	Gas flow proportional counter
Gross gamma	Gamma spectrometry
Cesium-137	Gamma spectrometry
Strontium-90	Gas flow proportional counter
Technetium-99	Gamma spectrometry
Uranium (total)	ICP
Plutonium (isotopic)	Radiochemical separation and alpha spectrometry
Cobalt-60	Gamma spectrometry
Tritium	Distillation and liquid scintillation
Chromium (total)	EPA Method 6010, ICP
Mercury	EPA Method 7470, Cold Vapor

7.12.3 SWMU No. 2-011 Sampling Plan

Phase I activities for SWMU 2-011 will include an engineering survey, radiological survey, surface soil/sediment sampling, subsurface sampling, and sampling of catch basins. These activities will be performed following LANL Standard Operating Procedures, as listed in Table 7.3-1. The total number of samples to be collected for SWMU 2-011 is summarized in Table 7.12-2.

TABLE 7.12-2
SUMMARY OF SAMPLES FOR OU 1098
PHASE I CHARACTERIZATION - SWMU 2-011

	Number of Samples		
	Soil/Sediment	Subsurface Soil	Catch basins
Analytical samples	4	12	8
QA samples			
Rinsate blank	0	1	1
Field duplicate	0	1	1
Field blank*	0	1	1
Total number of samples	4	15	11

* Field blank required only for samples collected for mercury, uranium, and chromium analyses.

7.12.3.1 Engineering and Radiological Surveys

An engineering survey will be performed to locate SWMU units 2-011(a) through (d) and recorded on base maps of the area.

A walkover radiation survey will be conducted along the drainlines and at the outfalls, to a distance of at least 5 ft of the discharge points of SWMUs 2-011(a), (b), and (d), to identify potential radiological anomalies, and will continue until field instruments detect no additional contaminant locations. Locations of elevated radioactivity, defined as greater than two standard deviations from the mean radiation level detected in the vicinity of TA-2, will be flagged and recorded in the field log with corresponding activities. At these locations, soil/sediment samples will be collected for mobile field lab measurement of gross alpha, beta, and gamma radiation. If point sources are identified on a case by case basis during these surveys, voluntary corrective actions (VCAs) to remove point sources and subsequent surface sampling may be implemented, when permitted.

7.12.3.2 Surface Sampling

Surface soil and sediment samples will be collected as shown in Figure 7.12-1 to a depth of 0 to 12 in. A total of four surface samples will be collected at the outfalls of 2-011(a)vi, (a)ix, (b)ii, and (c) to ascertain the presence or absence of surface soil contamination at these outfalls. Sampling locations will be moved to areas of radiological anomalies, as defined above, if detected.

Any contaminated material on or near the surface will be treated as a potential source of contamination. Therefore, when feasible, such near-surface contaminated material will be removed as a VCA. Soil samples that are in contact with any contaminated material will be characterized.

7.12.3.3 Subsurface Sampling

Subsurface soil samples will be collected from four borings at the outfalls of 2-011(a)vi, (a)ix, (b)ii, and (c) to ascertain the presence or absence of subsurface soil contamination at these outfalls. The boring locations will be moved to locations of radiological anomalies, as defined above, if detected.

A hollow-stem auger will be used to drill the characterization borings to a minimum depth of 15 ft to determine if subsurface soils have been contaminated. A 5-ft-long split-barrel core sampler will be used to collect continuous soil/rock samples in 5-ft intervals. When the core sample is retrieved, it will be screened along its entire length for radiation. One sample will be collected at a depth of 0 to 12 in. from each boring. One to three samples will be collected from the remaining depth of each boring, with at least one taken from the section of core with the highest observed radioactivity. If no anomalous radioactivity is detected, the samples will be collected based on lithology and visual observations. The exact depth of each sample collected will be recorded in the field log. Drilling may be continued to greater than 15 ft depth if field screening determines that two consecutive core intervals show anomalous radioactivity, as defined in section 7.12.3.1.

7.12.3.4 Catch Basin Sampling

A total of eight sediment samples will be collected from four catch basins (two samples per catch basin) associated with storm water drainage around TA-2-1. These catch basins are TA-2-36, TA-2-27, TA-2-28, and an unnumbered basin immediately south of building TA-2-1, as shown on Figure 7.12-1. Samples will be collected in accordance with LANL procedures presented in Table 7.3-1.

7.12.4 Sample Screening and Analysis

All sample packages will be screened for radiation using an alpha scintillometer, micro R meter, and pancake GM counter prior to shipment to the laboratory for analysis. Table 7.12-3 summarizes the number of samples to be analyzed for each specified method of analysis in Table 7.12-1 for SWMU 2-011 samples. Present screening action levels, practical quantitation limits, analytical methods, and required sample size for each analyte are presented in Table 5.1 in the Quality Assurance Project Plan for OU 1098 (Annex II of this work plan).

TABLE 7.12-3
SUMMARY OF ANALYSES FOR OU 1098
PHASE I CHARACTERIZATION - SWMU 2-011

Level III Method	Number of analyses		
	Surface Soil/sediment	Subsurface Soil	Catch Basin
Gas flow proportional counter	4	14	10
Gamma spectrometry	4	14	10
Radiochemical separation and alpha spectrometry	4	14	10
Distillation and liquid scintillation	4	14	10
EPA Method 6010, ICP	4	15	11
EPA Method 7470, Cold Vapor	4	15	11

7.13 SWMU NO. 2-012, DESCRIPTION OF POTENTIAL SOIL CONTAMINATION UNDER FORMER TANKS

7.13.1 Site Description and History

SWMU no. 2-012 consists of potential soil contamination below two underground storage tanks, TA-2-29 and TA-2-67 (DOE 1987, 0246). Storage tank TA-2-29 was a 1000-gal. fuel oil tank located on the south side of building TA-2-1. Although it was removed in 1950, removal efforts were not formally documented (LASL, 0402). Storage tank TA-2-67 was installed in approximately 1982 and is located on the north side of building TA-2-1. The 517-gallon underground tank stores diesel fuel for an auxiliary generator in building TA-2-1 (LASL, 0402). This tank is scheduled for removal as a VCA in this RFI. It is believed that several diesel fuel tanks have been sited in the same location as TA-2-67. The approximate locations for both of these underground storage tanks (SWMU no. 2-012) are shown in Figure 7.13-1 (Neely 1992, 14-0008). No releases from these tanks have been documented (DOE 1987, 0264).

7.13.2 Sampling Objectives and Potential Contaminants

It is possible that small quantities of diesel fuel contaminants may have leaked from the fuel oil tanks. Subsurface contamination may be present beneath the former location of tank TA-2-29, and may also be present beneath the present location of tank TA-2-67. Tank TA-2-67 is scheduled to be removed as a VCA for this RFI; therefore, sampling efforts will be deferred until the tank's removal. Phase I sampling for tank TA-2-29 will be done to determine the presence or absence of subsurface contamination associated with diesel fuel leakage.

The contaminants likely to be present in subsurface soils due to diesel fuel leakage include semivolatile organics, volatile organics, and petroleum hydrocarbons. Additionally, the possibility exists that metal additives were constituents of the fuel stored in the tank. Therefore, samples collected for TA-2-29 will be analyzed for semivolatiles, volatiles, total petroleum hydrocarbons, and inorganics as well as other TA-2 indicator contaminants (see Section 7.1) as summarized in Table 7.13-1.

TABLE 7.13-1
POTENTIAL CONTAMINANTS FOR SWMU 2-012

Potential Contaminant	Level III Method
Inorganics	EPA Method 6010, ICP
Semivolatile organics	EPA Method 8270
Volatile organics	EPA Method 8240
Total petroleum hydrocarbons	EPA Method 3550/418.1
	other methods for radionuclides

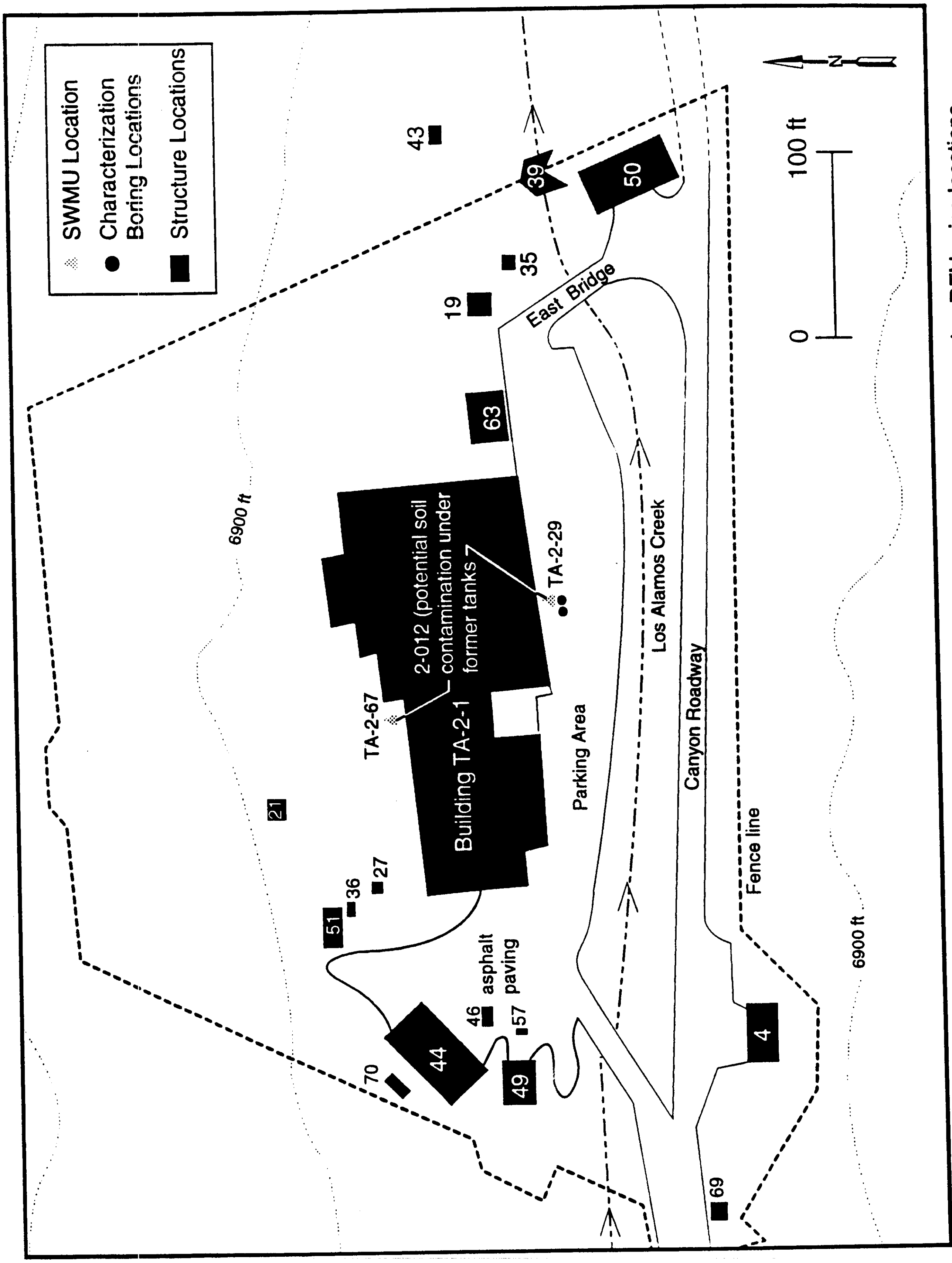


Figure 7.13-1 Proposed SWMU no. 2-012, potential soil contamination under former tanks, RFI boring locations.

7.13.3 SWMU No. 2-012 Sampling Plan

Phase I activities for SWMU 2-012 will include an engineering survey and subsurface sampling. These activities will be performed following LANL Standard Operating Procedures, as listed in Table 7.3-1. The total number of samples to be collected for SWMU 2-012 is summarized in Table 7.13-2.

TABLE 7.13-2
SUMMARY OF SAMPLES FOR OU 1098 PHASE I
BASELINE CHARACTERIZATION - SWMU 2-012

	Number of Samples	
	Soil/Sediment	Subsurface Soil
Analytical samples	0	6
QA samples		
Rinsate blank	0	1
Field duplicate	0	1
Field blank	0	1
Trip blank	0	1
Total number of samples	0	10

7.13.3.1 Engineering Survey

An engineering survey will be performed to locate the former location of tank TA-2-29. This data will be recorded on base maps of the area.

7.13.3.2 Surface Sampling

No surface samples are planned for this SWMU because any contamination as a result of storage tank leakage would be found at depth.

7.13.3.3 Subsurface Sampling

Subsurface soil samples will be collected from two boreholes at SWMU 2-012 at the former site of tank TA-2-29, as shown in Figure 7.13-1. Samples will be collected from these borings to assess presence or absence of contamination at depth due to possible leakage of contaminants from the storage tank.

A hollow-stem auger or other suitable method will be used to drill the characterization borings to a minimum depth of 15 ft to determine if subsurface soils have been contaminated. The depth of the tank is unknown, but is probably less than 15 ft, which is the general depth to the alluvial water table. A 5-ft-long split-barrel core sampler will be used to collect continuous soil/rock samples in 5-ft intervals. When the core sample is retrieved, it will be screened along its entire length for volatile organics with an OVA or PID, and for radiation. One sample will be collected from each boring at a depth of 0 to 12 in. One to three samples will be collected from the remaining depth of each boring, with at least one taken from the section of core with the highest observed organic activity or radioactivity. If no anomalous organic activity or radioactivity is detected, the samples will be collected based on lithology and visual observations. The exact depth of each sample collected will be recorded in the field log. Drilling may be continued to a depth greater than 15 ft if field screening determines that two consecutive core intervals show anomalous organic activity or radioactivity.

7.13.4 Sample Screening and Analysis

All sample packages will be screened for radiation using an alpha scintillometer, micro R meter, and pancake GM counter prior to shipment to the laboratory for analysis. Table 7.13-3 summarizes the number of samples to be analyzed for each specified method of analysis in Table 7.13-1 for SWMU 2-012 samples. Present screening action levels, practical quantitation limits, analytical methods, and required sample size for each analyte are presented in Table 5.1 in the Quality Assurance Project Plan for OU 1098 (Annex II of this work plan).

TABLE 7.13-3
SUMMARY OF ANALYSES FOR OU 1098
PHASE I CHARACTERIZATION - SWMU 2-012

Level III Method	Number of analyses	
	Surface Soil/sediment	Subsurface Soil
EPA Method 6010, ICP	0	9
EPA Method 8270	0	9
EPA Method 8240	0	10
Radioactivity Methods		
EPA Method 3550/418.1	0	9

7.14 SWMU 41-001: SEPTIC SYSTEM

7.14.1 Site Description and History

SWMU 41-001 is an abandoned septic tank (TA-41-11) which appears in engineering drawing ENG-4 1490. The tank is connected via a 4-in. VCP to TA-41-2, a guard house (DOE 1987, 0264). The original guard house has since been replaced but the sewer pipe and septic tank are believed to remain in place. The tank empties into a single 4-in. drain tile line that runs west to east (downslope) several feet south of the septic tank. The drain tile line is approximately 60 ft in length and its west end begins at the fence gate (see Figure 7.14-1). The tank presently is inactive; it was in operation from 1949 until 1953. The tank received sanitary and liquid wastes from the TA-41-2 guard shack. It is believed by current TA-41 employees that the tank served a single bathroom; however, one report (Balo and Warren, 1986, 0022) indicated that the tank was radioactively contaminated with low levels of plutonium, uranium, and tritium. There are no known past discharges to this tank that could account for radioactive or hazardous materials.

In a site visit to TA-41, a worker stated that the slope topography overlying the drain tile line was disturbed due to soil erosion. However, the original (1949) fence downslope of the septic tank and drain tile shows that the elevation of the ground surface has increased approximately 3 ft as indicated by the 6- to 7-ft-high fence that protrudes from the ground only 3 to 4 ft. Additional evidence such as loose dirt, gopher diggings, and a present topography not ideal for the septic system and drain tile indicate the possibility that fill has been placed over the septic system area. This fill might have come from the excavation of a sump (SWMU 41-003) or other construction in the area.

7.14.2 Sampling Objectives and Potential Contaminants

Archival information from 1986 indicates that this septic tank is contaminated with plutonium, uranium, and tritium. Engineering drawings show that this septic tank was connected to a guard shack, but not to laboratory facilities. Thus, it is unknown where this radioactive contamination originated, and whether the tank may be contaminated with non-radioactive constituents. The Phase I investigation for this site is designed to confirm the absence or presence of radioactive and non-radioactive contamination of this septic tank.

Potential contaminants of concern for this septic tank include the radiological constituents mentioned in the Balo and Warren report (1986, 0022), plutonium, uranium, tritium, and gross alpha/beta. Additionally, Appendix IX constituents (inorganics, semivolatiles, and volatile organics) will be analyzed to confirm their presence or absence in the septic system. Table 7.14-1 summarizes the potential contaminants of concern for this site.

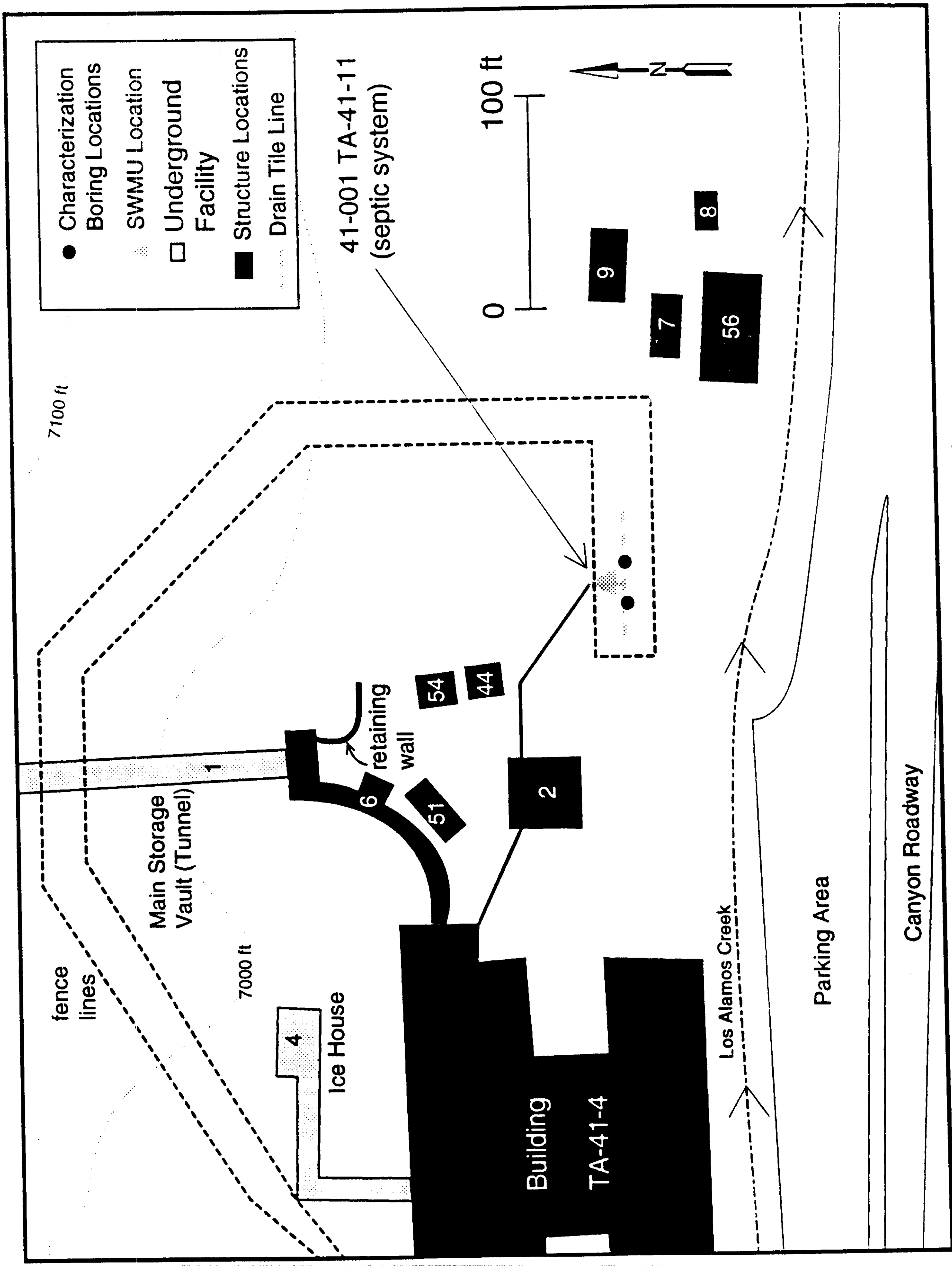


Figure 7.14-1 Proposed SWMU no. 41-001, septic system, RFI boring locations.

TABLE 14-1
POTENTIAL CONTAMINANTS FOR
SWMU 41-001

Potential Contaminant	Level III Method
Gross alpha/beta	Gas flow proportional counter
Gross gamma	Gamma spectrometry
Uranium (total)	ICP
Plutonium (isotopic)	Radiochemical separation and alpha spectrometry
Tritium	Distillation and liquid scintillation
Inorganics (including beryllium and lead)	EPA Method 6010, ICP
Mercury	EPA Method 7470, cold vapor
Semivolatile organics	EPA Method 8270
Volatile organics	EPA Method 8240

7.14.3 SWMU 41-001 Sampling Plan

Phase I activities for SWMU 41-001 will include an engineering survey, radiological survey, and sampling of the septic tank. A geophysical survey will be done if the engineering survey fails to locate the septic tank and drain tile. Samples will be collected from the septic tank, if located. If the septic tank is not located, borings will be done in the drain tile area and samples collected from the cores. These activities will be performed following LANL Standard Operating Procedures, as listed in Table 7.3-1. The total number of samples to be collected for SWMU 41-001 is summarized in Table 7.14-2.

TABLE 7.14-2
SUMMARY OF SAMPLES FOR OU 1098
PHASE I CHARACTERIZATION - SWMU 41-001

	Number of Samples	
	Septic tank sludge/sediment	Subsurface Soil*
Analytical samples	2	(6)***
QA samples		
Rinsate blank	1	(1)
Field duplicate	1	(1)
Field blank**	1	(1)
Trip blank	1	(1)
Total number of samples	6	(10)***

* *An average of three soil samples will be collected per borehole*

** *Field blanks submitted for non-radiological analyses only*

*** *Subsurface soil samples will be collected only if the septic tank cannot be located and sludge/sediment samples of the tank are not collected.*

7.14.3.1 Engineering, Geophysical, Radiological, and Organic Vapor Surveys.

An engineering survey will be performed to locate SWMU 41-001, the septic tank and drain tile. Additionally, probes will be used to accurately locate the septic tank structure. The location of the septic tank and drain tile will be recorded on base maps of the area.

A geophysical survey will be done to locate SWMU 41-001 if the septic tank and drain tile cannot be located in the field utilizing engineering drawings and probing. This investigation will most likely utilize ground-penetrating radar or other techniques appropriate for the area.

An organic vapor survey, using a Photo Ionization Detector (PID) or Flame Ionization Detector (FID) will be done upon excavation of the top of the septic tank and collection of the two sludge/sediment samples from the tank. Additionally, if borings are drilled in the rain tile, cores will be screened with the PID or FID for organic vapors.

A radiation survey will be conducted in the drain tile area to identify potential radiological anomalies and will continue until detectors reveal no additional contaminant locations. Locations of elevated activity, defined as greater than two standard deviations from the mean radiation level detected in the vicinity of TA-41, will be flagged and recorded in the field log with corresponding activities. At these locations, soil/sediment samples will be collected for mobile field lab measurement of gross alpha, beta, and gamma radiation. Additionally, samples from the septic tank will be field screened for radiation as they are collected. If point sources are identified at SWMU 41-001, on a case-by-case basis, during these surveys, voluntary corrective actions (VCAs) to remove point sources and subsequent surface sampling may be implemented after disposal of waste (potentially mixed) has been approved by EPA.

7.14.3.2 Septic Tank Sampling

The septic tank will be located in the field utilizing a probe and engineering drawings. Once the tank is found, soil above the tank will be excavated to the top of the septic tank,and the top of the tank will be removed. Organic vapor and radiological screening will be conducted when the top of the tank is removed. Two samples will be collected of the sludge/sediment in the tank, following LANL SOPs listed in Table 7.3-1.

Any contaminated materials on or near the surface will be treated as a potential source of contamination. Therefore, when feasible, such near-surface contaminated materials will be removed as a VCA. Soil samples that are in contact with any contaminated materials will be characterized.

7.14.3.3 Subsurface Sampling

If the engineering survey, probing, and geophysical survey fail to locate the septic tank, subsurface samples will be taken from two characterization boreholes in the drain tile to determine presence or absence of potential contaminants of concern associated with the septic tank. These subsurface samples will be taken at the outfall of the septic tank, if located, as shown on Figure 7.14-1. Borehole locations will be moved to areas of anomalous radioactivity, if detected in the drain tile.

The borehole will be drilled by a hollow-stem auger to a minimum depth of 15 ft. Sample location will begin at a depth of 7 ft to avoid sampling soils above the level of the septic tank. A 5-ft-long split-barrel sampler will be used to collect continuous soil/rock samples. When the core sample is retrieved, it will be screened along its entire length for radiation. Two to four samples will be collected from the boring with at least one taken from the section of core having the highest observed radioactivity or organic vapor activity. If no anomalous activity is detected, samples will be collected from a core interval based on lithology and visual observations. The exact depth of each sample collected will be recorded in the field log. Drilling may be continued to depths greater than 15 ft if two consecutive core intervals show anomalous radioactivity or organic vapor activity.

7.14.4 Sample Screening and Analysis

All sample packages will be screened for radiation using an alpha scintillometer, micro R meter, and pancake GM counter prior to shipment to the laboratory for analysis. Table 7.14-3 summarizes the number of samples to be analyzed for each specified method of analysis in Table 7.14-1 for SWMU 41-001 samples. Present screening action levels, practical quantization limits, analytical methods, and required sample size for each analyte are presented in Table 5.1 in the Quality Assurance Project Plan for OU 1098 (Annex II).

TABLE 7.14-3
SUMMARY OF ANALYSES FOR OU 1098
PHASE I CHARACTERIZATION - SWMU 41-001

Level III Method	Number of analyses Septic tank Sludge/Sediment	 Subsurface Soil*
Gas flow proportional counter	4	(8)
Gamma spectrometry	4	(8)
Radiochemical separation and alpha spectrometry	4	(8)
Distillation and liquid scintillation	4	(8)
EPA Method 6010, ICP	5	(9)
EPA Method 8270	5	(9)
EPA Method 8240	6	(10)

**Subsurface soil samples will be collected only if the septic tank cannot be located and sludge/sediment samples from the tank are not collected.*

7.15 SWMU 41-002, THE SEWAGE TREATMENT PLANT

7.15.1 Site Description and History

SWMU 41-002, the sewage treatment plant at TA-41, consists of three parts (Figure 7.15-1):

1. SWMU 41-002(a) is an Imhoff tank and an 800-cu-ft chlorinator (TA-41-7),
2. SWMU 41-002(b) is a contact tank (TA-41-8), and
3. SWMU 41-002(c) is a sludge drying bed (TA-41-9).

The sewage treatment plant at TA-41 was built in 1951, and received sanitary waste until 1987 from TA-41 and TA-2. Sewage from TA-2 was pumped to the plant after the early 1970s. Presently, wastes from TA-41 and TA-2 are being pumped to TA-3 for treatment. The treatment plant has been retained as a standby unit in the event of a lift pump failure. If the sewage treatment plant is in use, it discharges to a NPDES-permitted outfall in Los Alamos Canyon (NPDES no. SSS 06s). According to Francis (1992, 14-0040), it is standard procedure for all sewage treatment plants to routinely check the sewage sludge for radiation, toxics, and heavy metals. If these are found to be absent, the sludge is taken to TA-54 for off-site disposal. If the sludge is found to be contaminated, the sludge is taken to TA-54 to be shipped on-site for proper disposal. No records have been found on the toxics and heavy metals testing of the sludge from TA-41; however, detailed records have been found on radiation testing of the sludge from 1978 to 1986 and results are summarized below. In addition, samples were taken of the sewage entering tank TA-41-7 in 1955, as well as from effluent from the chlorine contact tank. At that time gross alpha counts ranged from 109 to 123 pCi/L (DOE 1987, 0264).

Results from the periodic testing of both liquid effluent and dried sludge from the plant during 1978 to 1986 are as follows (Rad Data 1992, 14-0043):

1. Alpha measurements on the liquid showed generally less than 2 pCi/L with levels as high as 7 pCi/L in February 1984. Dried sludge samples showed elevated alpha/beta levels, averaging approximately 8 pCi/g, with levels as high as 140 pCi/g in January 1981 (background for alpha/beta is approximately 20 pCi/g for sediments),
2. Beta radiation measurements on liquid effluent showed an average of about 6 pCi/L with measurements as high as 156 pCi/L in January 1983. Beta measurements on sludge samples averaged about 10 pCi/g, with levels as high as 80 pCi/g in December 1982,
3. Gamma measurements on liquid effluent averaged around 50 pCi/L, with levels as high as 1443 pCi/L in December 1979. Sludge samples averaged about 7 NCPM/g (net counts per minute), with levels as high as 30 NCPM/g, and

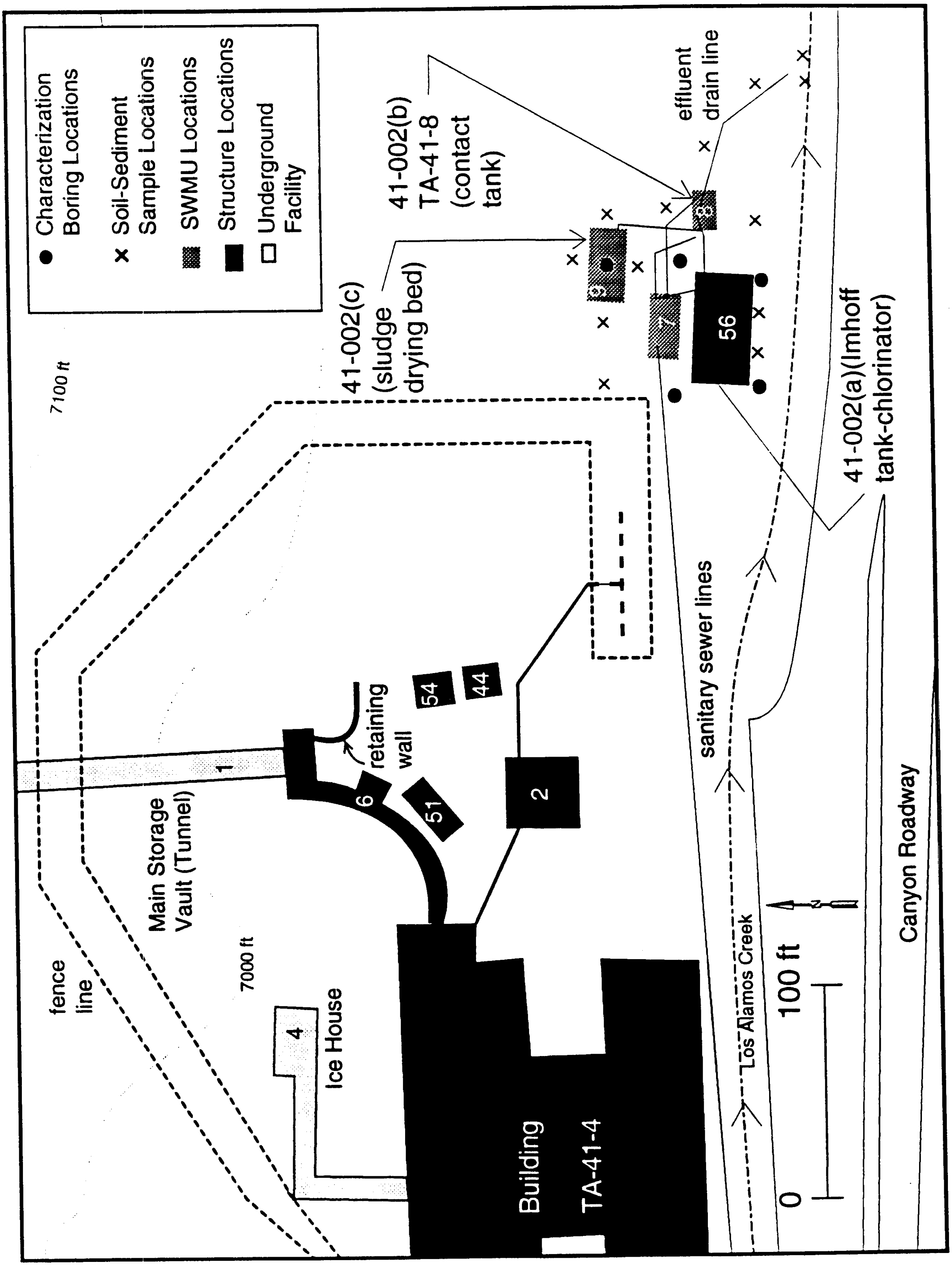


Figure 7.15-1 Proposed SWMU no. 41-002, sewage treatment plant, RFI boring-soil sampling locations.

4. Tritium levels in the liquid effluent from the sewage treatment plant were highly variable but generally ranged between 100 and 5000 pCi/L (background for the Los Alamos area is less than 50 pCi/L for groundwater in the main aquifer within Santa Fe Group sediments). The sludge samples showed tritium concentrations ranging from 1300 pCi/L up to 3 100 000 pCi/L. Six sludge samples showed elevated concentrations of tritium: In June 1984 the sludge showed 2,200,000 pCi/L; in August 1984, 3,100,000 pCi/L; in December 1984, 340,000 pCi/L; in August 1985, 1,400,000 pCi/L; in April 1986 150,000 pCi/L; and in August 1986, 20,000 pCi/L (Larson and Longmire 1992, 14-0001).

7.15.2 Sampling Objectives and Potential Contaminants

Documentation shows there have been several episodes of contamination within the sewage treatment plant, SWMU no. 41-002(a) through (c), especially with tritium. It is unknown, however, whether surrounding soils and sediments have been contaminated due to plant operations, such as overflows or aerosolization of effluent and subsequent fallout around the plant. Additionally, there has been no testing of the sludge for non-radioactive contaminants, which more than likely entered the plant due to laboratory operations at TA-2 and TA-41. Therefore, Phase I investigations for SWMU 41-002(a) through (c) are designed to determine presence or absence of surface and subsurface contamination around the sewage treatment plant and around the effluent discharge outfall to the creek.

Potential contaminants of concern for the sewage treatment plant include potential contaminants from both TA-2 and TA-41 operations. These include gross alpha and beta, tritium, uranium, plutonium, cesium-137, strontium-90, technetium-99, cobalt-60, mercury, beryllium, and lead. Additionally, samples collected for SWMU 41-002 will be analyzed for semivolatile and volatile organics, as well as other inorganics, to detect the presence of contamination due to laboratory operations at TA-2 and TA-41. Table 7.15-1 summarizes the constituents to be analyzed for SWMU 41-002.

TABLE 7.15-1
POTENTIAL CONTAMINANTS FOR
SWMU 41-002

Potential Contaminant	Level III Method
Gross alpha/beta	Gas flow proportional counter
Gross gamma	Gamma spectrometry
Cesium-137	Gamma spectrometry
Strontium-90	Gas flow proportional counter
Technetium-99	Gamma spectrometry
Uranium (total)	ICP
Plutonium (isotopic)	Radiochemical separation and alpha spectrometry
Cobalt-60	Gamma spectrometry
Tritium	Distillation and liquid scintillation
Mercury	EPA Method 7470, Cold Vapor
Inorganics (including beryllium and lead)	EPA Method 6010, ICP
Semivolatile organics	EPA Method 8270
Volatile organics	EPA Method 8240

7.15.3 SWMU 41-002 Sampling Plan

Phase I activities for SWMU 41-002(a) through (c) will include an engineering survey, radiological survey, surface soil/sediment sampling, subsurface sampling, and sampling of the sludge from 41-002(c). These activities will be performed following LANL Standard Operating Procedures, as listed in Table 7.3-1. The total number of samples to be collected for SWMU 41-002 is summarized in Table 7.15-2.

TABLE 7.15-2
SUMMARY OF SAMPLES FOR OU 1098
PHASE I CHARACTERIZATION - SWMU 41-002

	Number of Samples		
	Soil/Sediment	Subsurface Soil	Sludge Drying Bed
Analytical samples	13	12	3
QA samples			
Rinsate blank	1	1	1
Field duplicate	1	1	1
Field blank*	1	1	1
Trip blank	1	1	1
Total number of samples	17	16	7

** Field blanks will be submitted for non-radiological analyses only.*

7.15.3.1 Engineering and Radiological Surveys

Engineering and geophysical surveys will be done to locate the effluent lines and outfall to the creek from the sewage treatment plant. This data will be recorded on base maps of the area.

A walkover radiation survey will be done around the sewage treatment plant, along effluent lines, and to the outfall to the creek to identify radiological anomalies. Locations of elevated activity, defined as greater than two standard deviations from the mean radiation level detected in the vicinity of TA-41, will be flagged and recorded in the field log with corresponding activities. At these locations, soil/sediment samples will be collected for mobile field lab measurement of gross alpha, beta, and gamma radiation. If point sources are identified on a case by case basis during this survey, voluntary corrective actions (VCAs) to remove point sources and subsequent surface sampling may be implemented, if permitted.

7.15.3.2 Surface Sampling

Thirteen surface soil and sediment samples will be collected as shown on Figure 7.15-1 to a depth of 0 to 12 in. Nine samples will be collected in a grid around the plant structures to identify potential surface contamination due to overflow or aerosolization of plant effluent. An additional two samples will be collected along the effluent drain line to identify potential contamination due to leakage of the drain line, and another two samples will be collected at the outfall to the creek. Sampling locations will be moved to areas of radiological anomalies, as defined above, if detected.

Any contaminated material on or near the surface will be treated as a potential source of contamination. Therefore, when feasible, such near-surface contaminated material will be removed as a VCA. Soil samples that are in contact with any contaminated material will be characterized.

7.15.3.3 Subsurface Sampling

Subsurface soil samples will be collected from a total of four characterization borings at SWMU 41-002, as shown on Figure 7.15-1. These borings will be placed around 41-002(a), the Imhoff tank and chlorinator, to confirm presence or absence of potential contaminants of concern at depth around the structure. The boring locations will be moved to locations of radiological anomalies, as defined above, if detected.

A hollow-stem auger or other suitable technique will be used to drill the characterization borings to a minimum depth of 15 ft to determine if subsurface soils have been contaminated. A 5-ft-long split-barrel core sampler will be used to collect continuous soil/rock samples in 5-ft intervals. When the core sample is retrieved, it will be screened along its entire length for radiation and organic vapors. One sample will be collected at a depth of 0 to 12 in. from each boring. One to three samples will be collected from the remaining depth of each boring, with at least one taken from the section of core with the highest observed radioactivity or organic vapor activity. If no anomalous activity is detected, the samples will be collected based on lithology and visual observations. The exact depth of each sample collected will be recorded in the field log. Drilling may be continued to a depth greater than 15 ft if field screening determines that two consecutive core intervals show anomalous radioactivity or organic vapor activity.

7.15.3.4 Sludge Drying Bed Sampling

One borehole will be placed in the center of the sludge drying bed, SWMU 41-002(c), to assess the level of contamination within the sludge and sediments below the drying bed. The thickness of the drying bed is unknown. A hollow-stem auger will be used to drill the boring through the drying bed and to at least 5 ft through sediments below the bed. A 5-ft-long split-barrel core sampler will be used to collect continuous soil/rock samples in 5-ft intervals. When the core sample is retrieved, it will be screened along its entire length for radiation and organic vapors. Two to four samples will be collected from each boring, with at least one taken from the section of core with the highest observed radioactivity or organic vapor activity. If no anomalous activity is detected, the samples will be collected based on lithology and visual observations. The exact depth of each sample collected will be recorded in the field log. Drilling may be continued to greater than 5 ft. below the bottom of the drying bed if field screening determines that two consecutive core intervals show anomalous radioactivity or organic vapor activity.

7.15.4 Sample Screening and Analysis

All sample packages will be screened for radiation using an alpha scintillometer, micro R meter, and pancake GM counter prior to shipment to the laboratory for analysis. Table 7.15-3 summarizes the number of samples to be analyzed for each specified method of analysis in Table 7.15-1 for SWMU 41-002 samples. Present screening action levels, practical quantitation limits, analytical methods, and required sample size for each analyte are presented in Table 5.1 in the Quality Assurance Project Plan for OU 1098 (Annex II).

TABLE 7.15-3
SUMMARY OF ANALYSES FOR OU 1098
PHASE I CHARACTERIZATION - SWMU 41-002

Level III Method	Surface Soil/sediment	Subsurface Soil	Number of Analyses Sludge Drying Bed
Gas flow proportional counter	15	14	5
Gamma spectrometry	15	14	5
Radiochemical separation and alpha spectrometry	15	14	5
Distillation and liquid scintillation	15	14	5
EPA Method 6010, ICP	16	15	6
EPA Method 7470, Cold Vapor	16	15	6
EPA Method 8270	16	15	6
EPA Method 8240	17	16	7

7.16 SWMU 41-003, DESCRIPTION OF SUMP

7.16.1 Site Description and History

Site drawing ENG-R 5122 indicates an inactive sump pit, TA-41-10. The sump is 3 ft 7-3/4 in. by 2 ft by 2 ft 6 in. deep and discharges to Los Alamos Canyon (DOE 1987, 0264) (Figure 7.16-1). The sump serviced TA-41-1 and handled storm water and the water used to hose out the storage tunnel at TA-41. The tunnel, which was built in 1948 and occupied by 1949, has been used to store TRU wastes and tritium, but past releases are unknown.

In the fall of 1988, the sump was completely excavated to make room for a concrete pad, retaining wall, HEPA housing, motor, fan, and a stack for the ventilation system upgrade for TA-41-1. At the time of the sump's excavation, a concrete lid to the sump and three pipes from the tunnel to the sump were found. Along with the sump and its associated pipes, 10 ft of soil from each side and below the sump were excavated. No contamination was found in the structures or surrounding soil. Note that the finding of no contamination in the structures and soil is according to a 1992 memo by R. Larson, a TA-41 site worker. Radiation survey documentation to support this finding has not been located. (Larson and Longmire 1992, 14-001)

The Larson memo states that the sump and associated pipe were excavated and placed in a new, unspecified location. In a telephone conversation held on October 19, 1992, Mr. Larson stated that the sump was reburied approximately 20 ft due south of its original location to make room for the concrete pad. (Larson and Brown 1992, 14-0042). Before construction of the new ventilation system was completed and the sump structure buried, the drain lines were capped at the sump structure, and the floor and sink drains in building TA-41-1 were plugged or capped. At the same time all water except the fire protection supply was removed from building TA-41-1 (Larson and Longmire 1992, 14-0001).

The soil in the area where the sump was excavated is soft, eroded Bandelier Tuff. When the sump was buried, a clean, coarser-grained soil was placed below the sump for proper compaction of the soil surrounding the sump. According to Mr. Larson (Larson and Brown 1992, 14-0046), a surplus of a mixture of this clean, coarse-grained soil and the eroded tuff that surrounded the sump was placed to the east of the guard shack (Figure 7.16-1). A site visit on October 15, 1992, confirmed the presence of a pile of fill in the area east of the guard shack. There was also an area that appeared to be fill located southeast of this, between the two fences surrounding TA-41. Mr. Larson indicated that this soil was original; however, the soil was generally uncompacted and appeared to be fill. It is possible that this soil could be excess fill material, mixed with original soil surrounding the sump.

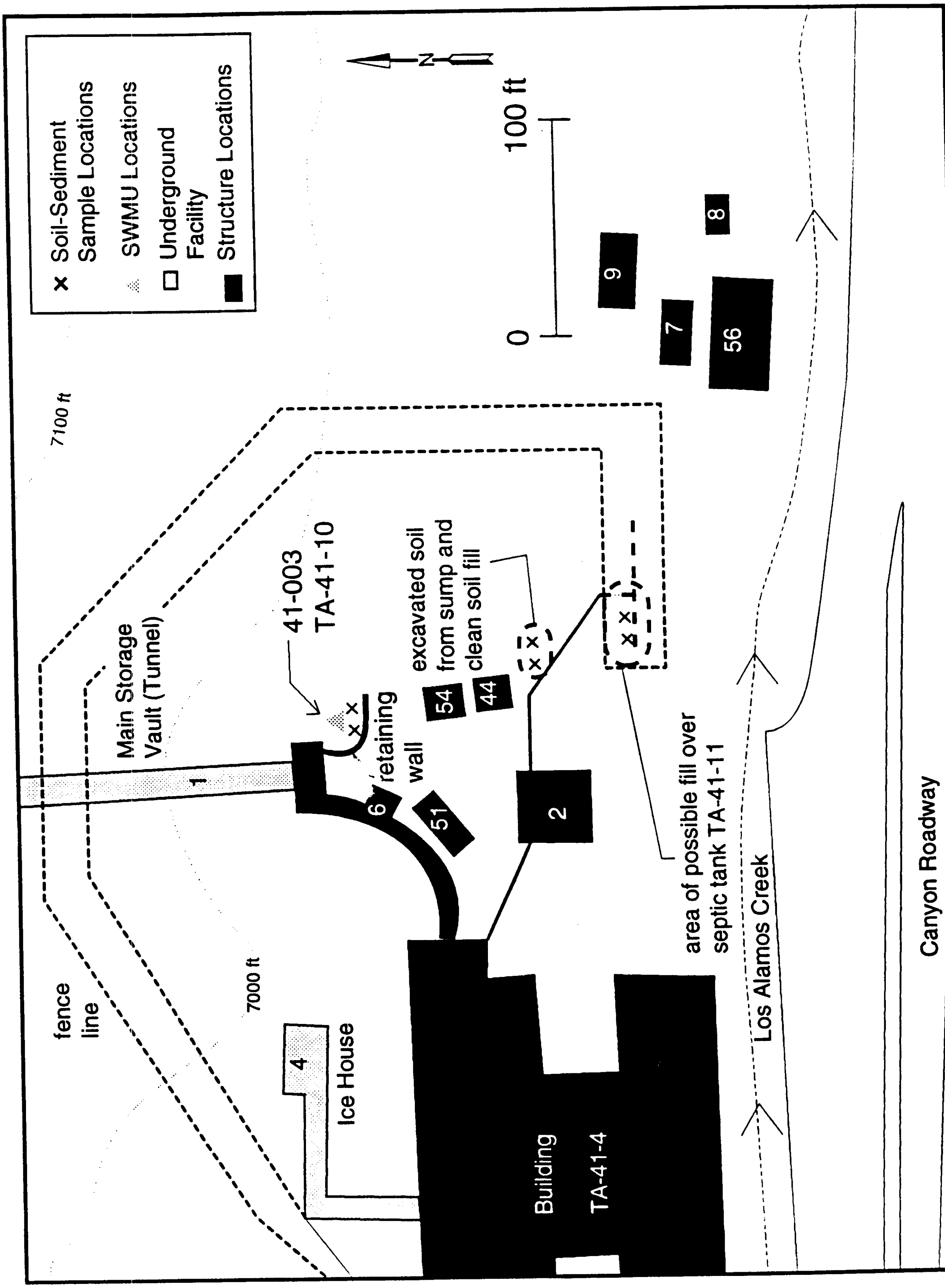


Figure 7.16-1 Proposed SWMU no. 41-003, sump, RFI soil sampling locations.

7.16.2 Sampling Objectives and Potential Contaminants

Phase I investigations at SWMU 41-003 will determine the presence or absence of potential contaminants of concern in the mixture of fill and soil excavated from around the sump. Since the sump structure is located beneath the ventilation system for the tunnel, the sump will not be sampled during Phase I activities. If the excavated and clean fill mixture is found to be contaminated, the sump will be investigated in later activities (Phase II). If the mixture is found to be clean, no further action (NFA) will be recommended for this SWMU.

Potential contaminants of concern for SWMU 41-003 are those constituents associated with operations within the tunnel, TA-41-1. These constituents include gross alpha/beta, tritium, uranium, isotopic plutonium, beryllium, lead, and mercury. Samples will be analyzed for these constituents, as summarized in Table 7.16-1.

TABLE 7.16-1
POTENTIAL CONTAMINANTS FOR
SWMU 41-003

Potential Contaminant	Level III Method
Gross alpha/beta	Gas flow proportional counter
Gross gamma	Gamma spectrometry
Uranium (total)	ICP
Plutonium (isotopic)	Radiochemical separation and alpha spectrometry
Tritium	Distillation and liquid scintillation
Inorganics (includes beryllium and lead)	EPA Method 6010, ICP
Mercury	EPA Method 7470, Cold Vapor

7.16.3 SWMU 41-003 Sampling Plan

Phase I activities for SWMU 41-003 include an engineering survey, radiological survey, and surface soil and sediment sampling. These activities will be performed following LANL Standard Operating Procedures, as listed in Table 7.3-1. The total number of samples to be collected for SWMU 41-003 is summarized in Table 7.16-2.

TABLE 7.16-2
SUMMARY OF SAMPLES FOR OU 1098
PHASE I CHARACTERIZATION - SWMU 41-003

	Number of Samples Septic tank sludge/sediment
Analytical samples	6
QA samples	
Rinsate blank	1
Field duplicate	1
Field blank*	1
Total number of samples	9

* *Field blanks submitted for non-radiological analyses only*

7.16.3.1 Engineering and Radiological Surveys

An engineering survey will be done to locate the areas where the clean and excavated soil mixture was placed. The locations of these fill areas will be recorded on base maps of the area.

A radiological survey will be done over the fill areas to identify potential radiological anomalies, and will continue until detectors reveal no additional contaminant locations. Locations of elevated activity, defined as greater than two standard deviations from the mean radiation level detected in the vicinity of TA-41, will be flagged and recorded in the field log with corresponding activities. At these locations, soil/sediment samples will be collected for mobile field lab measurement of gross alpha, beta, and gamma radiation. If point sources are identified at SWMU 41-003, on a case-by-case basis, during these surveys, voluntary corrective actions (VCAs) to remove point sources and subsequent surface sampling may be implemented if permitted.

7.16.3.2 Surface Sampling

Six surface samples will be collected for SWMU 41-003, as shown in Figure 7.16-1, at a depth of 0 to 12 in. Two samples will be collected from soil around the existing ventilation system outside of TA-41-1, over the area where the sump is now located. Four samples will be collected in the two areas of fill south of TA-41-1, as shown on Figure 7.16-1.

Any contaminated material on or near the surface will be treated as a potential source of contamination. Therefore, when feasible, such near-surface contaminated material will be removed as a VCA. Soil samples that are in contact with any contaminated material will be characterized.

7.16.4 Sample Screening and Analysis

All sample packages will be screened for radiation using an alpha scintillometer, micro R meter, and pancake GM counter prior to shipment to the laboratory for analysis. Table 7.16-3 summarizes the number of samples to be analyzed for each specified method of analysis in Table 7.16-1 for SWMU 41-003 samples. Present screening action levels, practical quantitation limits, analytical methods, and required sample size for each analyte are presented in Table 5.1 in the Quality Assurance Project Plan for OU 1098 (Annex II).

TABLE 7.16-3
SUMMARY OF ANALYSES FOR OU 1098
PHASE I CHARACTERIZATION - SWMU 41-003

Level III Method	Number of analyses Surface Soil/Sediment
Gas flow proportional counter	8
Radiochemical separation and alpha spectrometry	8
Distillation and liquid scintillation	8
EPA Method 6010, ICP	9
EPA Method 7470, Cold Vapor	9

7.17 AOC C-41-004, STORM DRAINAGES

7.17.1 Site Description and History

The storm drains for TA-41 are shown in Figure 7.17-1. Structures TA-41-22 through 28 are storm drainage catch basins/manholes. According to Rick Larson (Larson and Brown 1992, 14-0042), a TA-41 site worker, there have been no indications of contaminant releases into the storm drains. However, the stack between buildings TA-41-4 and TA-41-30 is known to have had operational releases of tritium in the past. Surface contamination of the storm drains might have resulted from these operational releases. No monitoring of the storm drains or outfalls has been done in the past (Larson and Brown 1992, 14-0042).

7.17.2 Sampling Objectives and Potential Contamination

The status of contamination within the storm drains, catch basins, and outfalls at TA-41 is unknown. Phase I activities will focus on sampling catch basins and outfalls of the storm drains to assess the presence or absence of contamination for this AOC. Additionally, sampling for the storm drains will help to assess the presence or absence of contamination due to undocumented releases of contaminants from past TA-41 operations.

Potential contaminants for TA-41 include gross alpha, beta, and gamma radioactivity, tritium, uranium, plutonium, and beryllium, lead, and mercury. All samples collected in the storm drain catch basins and outfalls will be analyzed for these constituents, as summarized in Table 7.17-1.

TABLE 7.17-1
POTENTIAL CONTAMINANTS FOR
AOC 41-004

Potential Contaminant	Level III Method
Gross alpha/beta	Gas flow proportional counter
Gross gamma	Gamma spectrometry
Uranium (total)	ICP
Plutonium (isotopic)	Radiochemical separation and alpha spectrometry
Tritium	Distillation and liquid scintillation
Inorganics (includes beryllium and lead)	EPA Method 6010, ICP
Mercury	EPA Method 7470, Cold Vapor

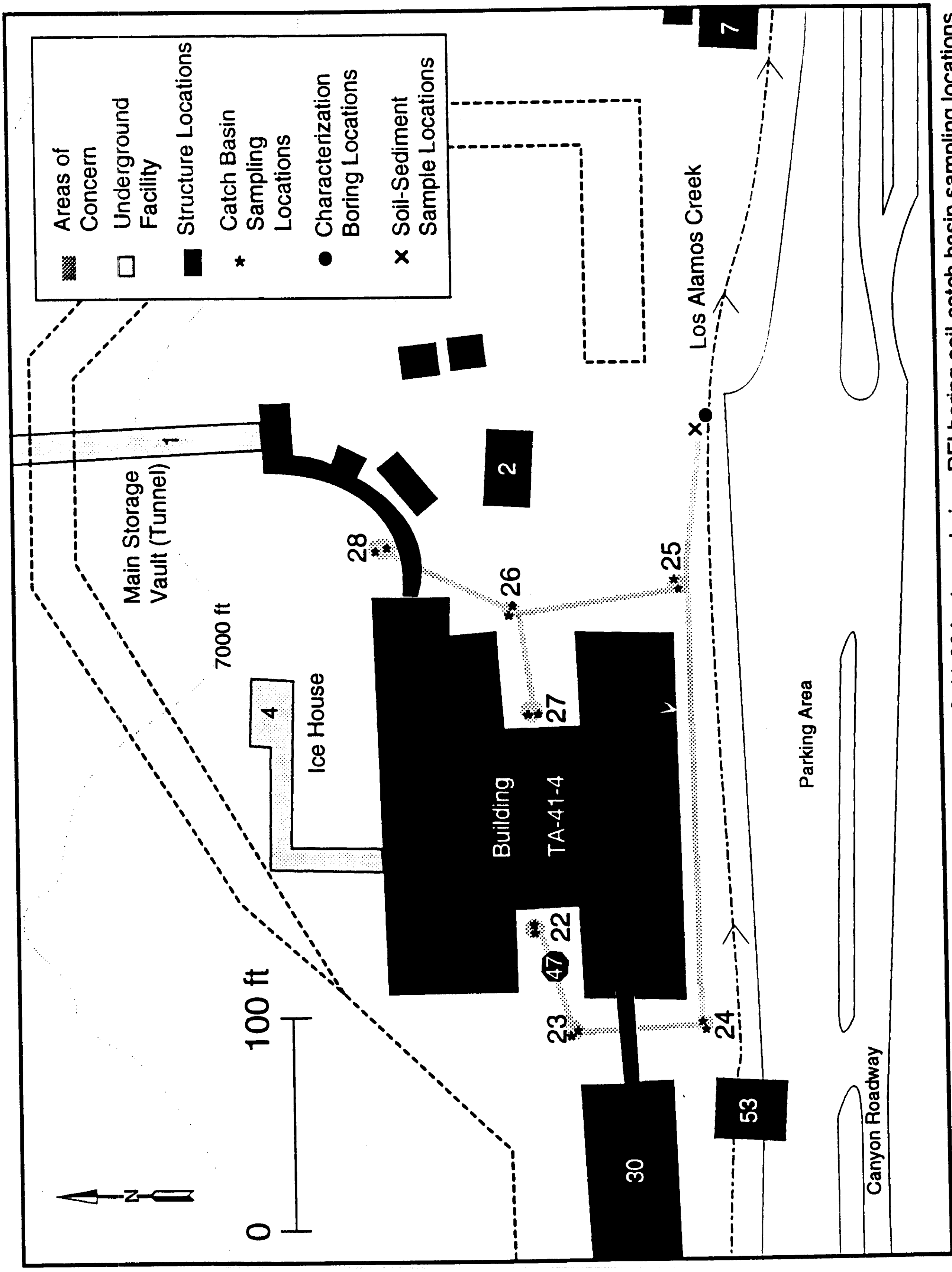


Figure 7.17-1 Proposed Areas of Concern C-41-004, storm drains, RFI boring-soil-catch basin sampling locations.

7.17.3 AOC C-41-004 Sampling Plan

Phase I activities for AOC C-41-004 will include an engineering survey, radiological survey, and surface and subsurface sampling. These activities will be performed following LANL Standard Operating Procedures, as listed in Table 7.3-1. The total number of samples to be collected for AOC 41-004 is summarized in Table 7.17-2.

TABLE 7.17-2
SUMMARY OF SAMPLES FOR OU 1098
PHASE I CHARACTERIZATION - AOC C-41-004

		Number of Samples	
	Surface Samples	Subsurface Samples**	Catch Basin Samples
Analytical samples	1	3	14
QA samples			
Rinsate blank	0	1	1
Field duplicate	0	1	1
Field blank*	0	1	1
Total number of samples	1	6	17

* *Field blanks submitted for non-radiological analyses only.*
** *An average of three subsurface samples will be collected from each borehole.*

7.17.3.1 Engineering and Radiological Surveys

An engineering survey will be performed to locate the storm drains, catch basins, and outfall to the creek. The locations of these structures will be recorded on base maps of the area.

A walkover radiological survey will be performed around the storm drains, catch basins, and the outfall to the creek to identify potential radiological anomalies, and will continue until detectors reveal no additional contaminant locations. Locations of elevated radioactivity, defined as greater than two standard deviatoins from the mean radiological level detected in the vicinity of TA-41, will be flagged and recorded in the field log with corresponding activities. At these locations, sediment samples will be collected for field lab measurement of gross alpha, beta, and gamma radiation. If point sources are identified at AOC C-41-004 during these surveys, voluntary corrective actions (VCAs) to remove point sources and subsequent surface sampling may be implemented on a case-by- case basis, if permitted.

7.17.3.2 Surface Sampling

One surface soil/sediment sample will be collected at the outfall of the storm drain system of TA-41 to the creek. The location of this sample is shown on

Figure 7.17-1. This sample location will be moved to any area of radiological anomaly, as defined above, if detected. Any debris on or near the surface will be treated as a potential source of contamination. Therefore, when feasible, such near-surface contaminated debris will be removed as a VCA. Soil samples in contact with any contaminated debris or artifacts will be characterized.

7.17.3.3 Subsurface Sampling

One characterization borehole will be collected at the outfall of the storm drains, as shown on Figure 7.17-1. This sample location will be moved to any area of radiological anomaly, as defined above, if detected. This characterization borehole is intended to confirm the presence or absence of COCs at depth in the creek bed below the storm drain outfall.

A hollow-stem auger rig will be used to drill the characterization boring to a minimum depth of 15 ft. A 5-ft-long split-barrel core sampler will be used to collect continuous soil/rock samples at 5-ft intervals. When the core sample is retrieved, it will be screened along its entire length for radiation. One sample will be collected at a depth of 0 to 12 in. One to three soil samples will be collected from the remaining depth of the boring, with at least one selected from the section of core with the highest observed radioactivity. If no anomalous radioactivity is detected, the samples will be collected based on lithology and visual observations. The exact depth of each sample collected will be recorded in the field log. Drilling may be continued to depths greater than 15 ft if field screening determines that two consecutive core intervals show anomalous radioactivity.

7.17.3.4 Catch Basin Sampling

A total of 14 sediment samples will be collected from the catch basins at TA-41, structures TA-41-22 through TA-41-28. The locations of these catch basins are shown on Figure 7.17-1. Two sediment samples will be collected from each catch basin.

7.17.4 Sample Screening and Analysis

All sample packages will be screened for radiation using an alpha scintillometer, micro R meter, and pancake GM counter prior to shipment to the laboratory for analysis. Table 7.17-3 summarizes the number of samples to be analyzed for each specified method of analysis in Table 7.17-1 for AOC 41-004 samples. Present screening action levels, practical quantitation limits, analytical methods, and required sample size for each analyte are presented in Table 5.1 in the Quality Assurance Project Plan for OU 1098 (Annex II of this work plan).

TABLE 7.17-3
SUMMARY OF ANALYSES FOR OU 1098
PHASE I CHARACTERIZATION - AOC C-41-004

Level III Method	Number of analyses Surface	Subsurface	Catch Basin
Gas flow proportional counter	1	5	16
Gamma spectrometry	1	5	16
Radiochemical separation and alpha spectrometry	1	5	16
Distillation and liquid scintillation	1	5	16
EPA Method 6010, ICP	1	6	17
EPA Method 7470, Cold Vapor	1	6	17

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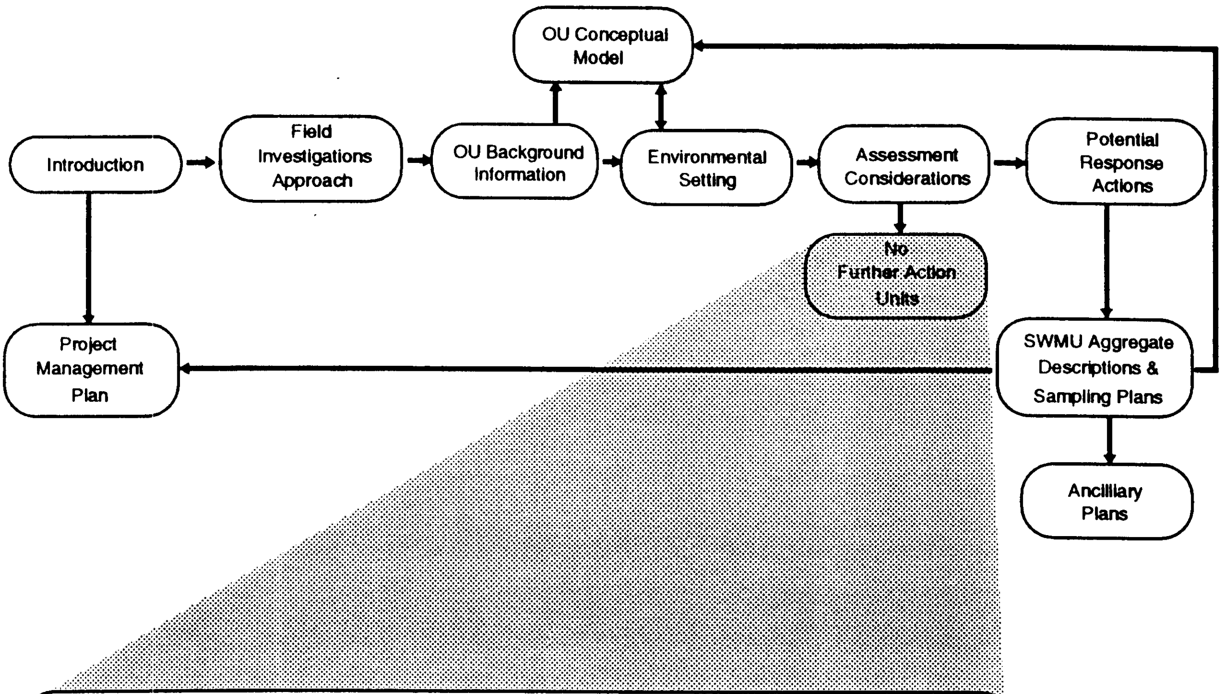
Chapter 8



Potential Release Sites for Consideration of No Further Action

- Introduction
- Burn Site
- Inactive Container Storage Area
- Active Hazardous Waste Storage Area
- Sump
- Diesel Tank
- Industrial Tank
- Fuel Tank

8.0 POTENTIAL RELEASE SITES FOR CONSIDERATION OF NO FURTHER ACTION (NFA)

8.1 Introduction

This chapter presents information on Solid Waste Management Unit (SWMU) nos. 2-001 (burn site), 2-002 (inactive container storage area), 2-013 (active hazardous waste container storage area), and 41-004 (container storage area), which are listed in the 1990 Laboratory SWMU report (LANL 1990, 0145) and are proposed for no further action (NFA) status based on archival information. In addition, this chapter discusses several listed Areas of Concern (AOC) at Technical Area-41 (TA-41) that were considered during the work plan development. Based on the information discussed in this chapter, a recommendation of NFA is proposed for the units listed below. Following regulatory concurrence, these areas will be considered suitable for unrestricted Laboratory use, subject to restrictions imposed by the ongoing use of TA-2 and TA-41.

The SWMUs proposed for NFA are as follows:

- Burn site (location unknown) (SWMU no. 2-001),
- Inactive container storage area (remediated) (SWMU no. 2-002),
- Active hazardous waste container storage areas (SWMU no. 2-013), and
- Container storage area (SWMU no. 41-004).

The following AOCs (all at TA-41) are also intended for NFA:

- sump (C-41-001)
- diesel tank (C-41-002)
- industrial waste tank (C-41-003)
- fuel tank (C-41-005)

Archival data for these PRSs indicate that it is appropriate to propose NFA under guidance proposed in Subpart S because these PRSs pose no threat to human health or the environment. The following criteria, which were provided by ER Program Office LANL 1992, 0768), were also used for proposing NFA for these units (based on archival data).

- ***NFA Criterion 1.*** The site or PRS has never been used for the management (that is, generation, treatment, storage, or disposal) of RCRA hazardous wastes or radionuclides.

- ***NFA Criterion 2.*** The site should be addressed by another program. For example, if the PRS is part of a process operating under the Laboratory's current RCRA Part B, National Pollutant Discharge Elimination System (NPDES) Permit, or other applicable discharge permit.
- ***NFA Criterion 3.*** The PRS has been properly closed.

The PRSs also may be recommended for NFA because archival data indicate that they do not pose a threat to human health or the environment, as defined by the following criteria:

- ***NFA Criterion 4.*** Site design, conditions, or institutional controls precludes any release from the PRSs that would pose a threat to human health or the environment.
- ***NFA Criterion 5.*** The PRS has been characterized or remediated in accordance with current applicable state or federal regulations, and the available data indicate that constituents are either not present or are present in concentrations near background levels.

If the criteria listed above are not sufficient for a recommendation of NFA, further review of archival data may lead to NFA based on the following considerations (described in detail in Appendix I, Section 4.1, of the IWP):

- applicable regulatory requirements,
- public concern,
- impact on Laboratory, programs, and operations, and
- value of information

If NFA cannot be recommended based on existing information alone, further study is warranted as outlined for OU 1098 in Chapter 7 of this work plan. No further action may be recommended following limited Phase I investigations or after baseline risk assessment based on the criteria presented in Chapter 6 (Sections 6.4.4 and 6.4.9, respectively). Specifically, a PRS may be considered for NFA following a screening assessment if the absence of COCs has been confirmed, provided that ecological impact is not significant and that multiple constituents, whose cumulative risk exceeds acceptable levels, are not detected. A PRS may be considered for NFA after baseline risk assessment if the calculated aggregate risk from all constituents (both human-health and ecological risk) does not exceed acceptable levels. For PRSs containing radiological constituents, the principles of ALARA must also be considered before any recommendation of NFA.

8.2 Burn Site (SWMU No. 2-001)

SWMU no. 2-001 may have consisted of a former burn pit for disposal of combustible materials from TA-2 (LANL 1990, 0145). A 1945 memorandum recommended that drums be provided at the burning pit for trash that could not be burned. Archival research shows that the past location of the site is unknown. In addition, in an interview, Glen Neely (an employee of TA-2 from 1960 to 1976) stated that he and his co-workers do not know the location of the site, and cannot confirm that the site ever existed.

No Phase I activities are planned for this SWMU because there have been no known releases of hazardous and radioactive materials for SWMU no. 2-001 and, in fact, SWMU no. 2-001 may have never existed. According to NFA Criterion 1 of Section 8.1, NFA is proposed for SWMU no. 2-001.

8.3 Inactive Container Storage Area (SWMU No. 2-002)

Oil-filled equipment was stored outside of building TA-2-1 for several years during the 1980s (LANL 1990, 0145) in an area of approximately 10 ft by 10 ft. Leaking oil from the equipment ran onto asphalt pavement and into an open storm ditch. In 1985, the oil was found to contain polychlorinated biphenyls (PCBs). The area was decontaminated by excavation of asphalt and soil to a depth of approximately 1 ft under the storage area. Several feet of the storm ditch were scraped and cleaned. Sampling and analysis showed the cleanup reduced PCBs to below a residual concentration of $\leq$ 1 ppm (LANL 1990, 0145). The area is presently inactive and has not been used for storage of any potential contaminants since the cleanup. Radioactive releases are not known to have occurred. The area has been cleaned up and decontamination efforts have been verified (LANL 1990, 0145). Figure 8.3-1 depicts the location of the SWMU no. 2-002.

No Phase I activities are planned for this SWMU because of previous successful remediation efforts (LANL 1990, 0145). According to NFA Criterion 5 of Section 8.1, NFA is proposed for SWMU no. 2-001.

8.4 Active Hazardous Waste Storage Area (SWMU No. 2-013)

There are three RCRA satellite container storage areas in various locations inside building TA-2-1 (LANL 1990, 0145). Two of the storage areas are for solvents from parts cleaning. The other area is used to store solvents and metals from experiments. Figure 8.4-1 shows the location of SWMU no. 2-013 (Penneman 1992, 14-0003).

Environmental monitoring has been performed in the immediate vicinity of these TA-2 active hazardous waste storage areas (Figure 8.4-1). There is no evidence that hazardous or radioactive materials have been spilled or discharged at this locality (Penneman 1992, 14-0003). Satellite areas that have not leaked are not SWMUs, and the technical team for OU 1098 has proposed to delete SWMU no. 2-013 in the revised HSWA-permit for the Laboratory. Therefore, according to NFA Criterion 2 listed in Section 8.1, NFA is proposed for SWMU no. 2-013.

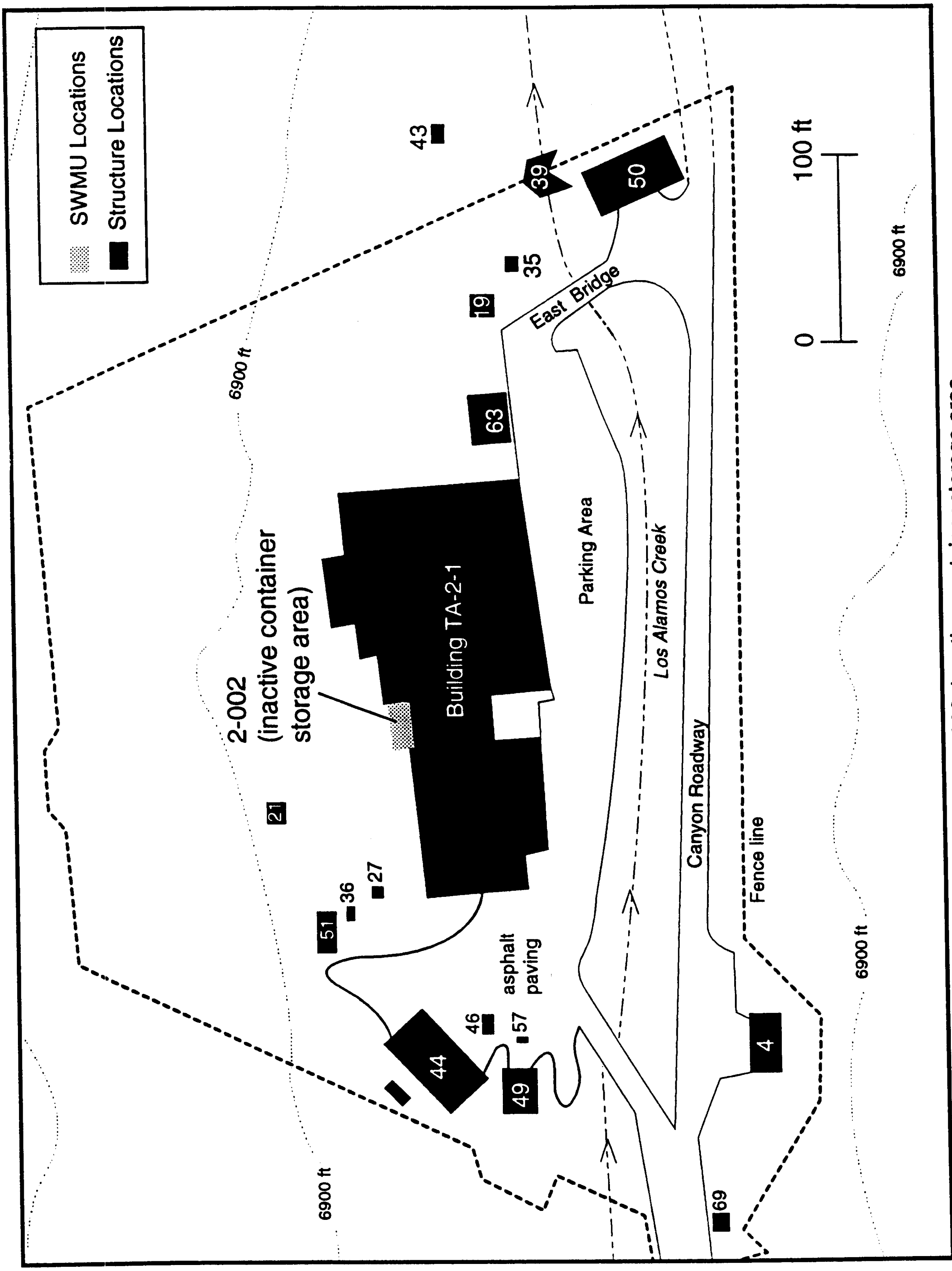


Figure 8.3-1 Location map of SWMU no. 2-002, inactive container storage area.

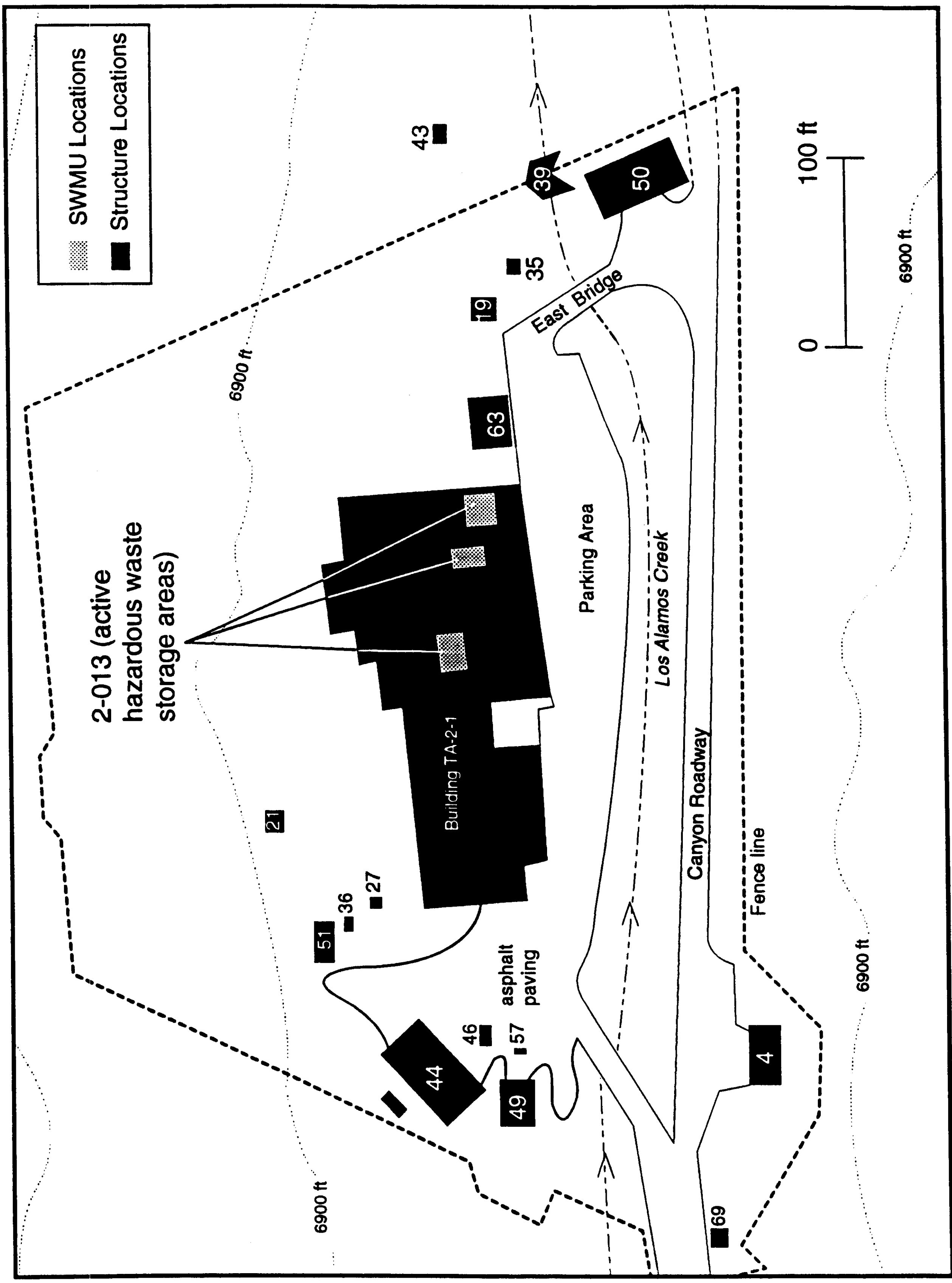


Figure 8.4-1 Location map of SWMU no. 2-013, active hazardous waste storage areas.

8.5 Container Storage Area (SWMU No. 41-004)

There is an active satellite container storage area in room 319 of TA-41-30 (Figure 8.5-1). The SWMU report indicates that the area stores waste from a photo-processing laboratory and office machines. An interview with C. Randall Mynard (Mynard 1992, 14-0007) of MEE-4, the group that currently occupies building TA-41-30, revealed that this area does not have any photo-processing activity but does currently store various chemicals in small amounts (less than 1 pint). These chemicals include ethanol, acetone, RTV sealant (silicone rubber), Epon (an epoxy), Versamid #140 (an epoxy hardener), and some wire solder. A blueprint machine is also located in this room. This machine uses ammonium hydroxide, but the chemical is stored only in the machine in this room.

The SWMU report also indicates the SWMU location as being room 310 and not the current storage area (room 319). According to Mr. Mynard, room 310 was used as the chemical storage room until 1991, when the chemicals were either disposed of via shipment to TA-54 or moved to room 319. The major chemicals stored in room 310 (as of June 3, 1991) were Loctite (maleic acid, four 1.69-oz bottles), Locquick Primer T (1,1,1-TCA, five 6-oz cans), spray lacquer (one 13-oz can), acetone (about 1 pint), WD-40 (one 12-oz can), Stycast 2850 epoxy (one small can), Catalyst 9 (2 oz), wire solder, and 85% ethanol (1 qt). All of these chemicals were kept in a storage cabinet. An inventory in May 1990 of room 310 showed the same chemical inventory with the addition of ammonium hydroxide (small quantity) used for a blueprint machine. The blueprint machine is located in room 319. Before 1989, this blueprint machine used gaseous ammonia hydroxide, which was stored in room 310 and on the loading dock to building TA-41-30. Mr. Mynard does not have a record of any spills of the liquid ammonium hydroxide or of any incidents with the other chemicals stored in the area.

The SWMU description also mentions a photo-processing laboratory with its associated wastes of sodium thiosulfate, ammonium hydroxide, silver salts, and kerosene-based chemicals. According to Mr. Mynard, the photo-processing laboratory was in room 242 of this same building. This room was a dark room with a portable photo-processing unit. Black-and-white and color photos were developed here from 1983 to 1990. The lab was not used heavily. Mr. Mynard, who worked in this lab, estimated that the maximum activity from the area was in 1986, when the workers used approximately 6 gal. of color developer.

The Mechanical and Electronic Engineering (MEE) Division, group MEE-4, has occupied this building since 1982. Before that, from 1978 to 1982, Design Engineering Division (WX), group WX-8 occupied the building, and from 1958 to 1978 WX-1 occupied the building. William A. Bradley worked with WX-8 and resided in the building when this group occupied the building. In an interview, he stated that the building was used as an office building and that no work requiring chemical storage took place. He did state that there were a couple of electronics laboratories in the building, but he does not recall any chemical storage areas present at that time (Bradley 1992, 14-0004). An interview with Bennie J. Gillespie (Gillespie 1992, 14-0005) who worked with WX-1, stated that the building was also used as office space during his time there and he does not recall any chemical storage areas in the building. Site inspections have revealed no visual evidence of releases from this site (Penneman 1992, 14-0009).

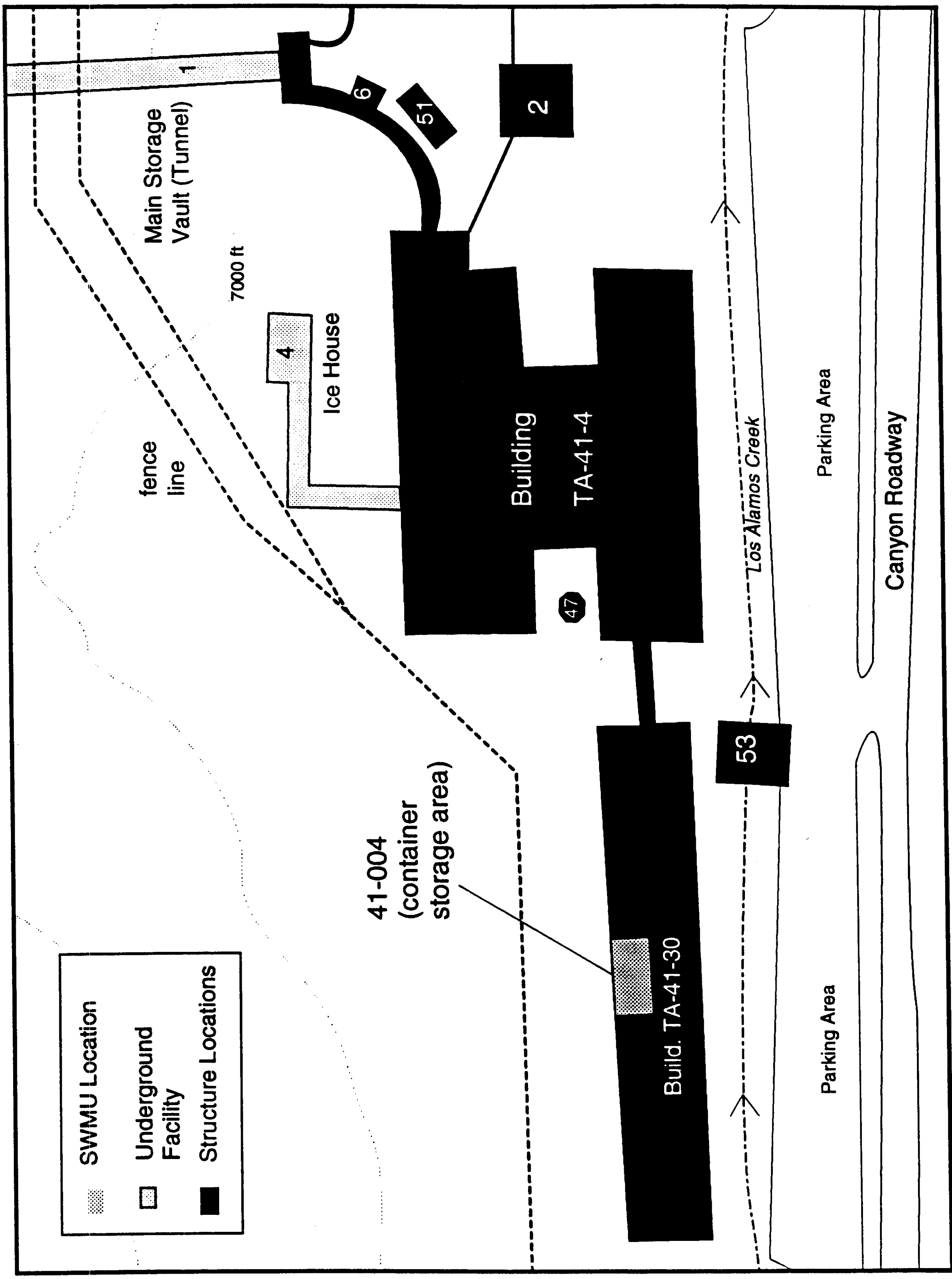


Figure 8.5-1 Proposed SWMU no. 41-004, container storage area.

Environmental monitoring is performed in the immediate vicinity of the TA-41 container storage area. There is no evidence that hazardous or radioactive materials were spilled or discharged at this locality. Consequently, it is very unlikely that the container storage area is a release site. Therefore, according to NFA Criterion 4 listed in Section 8.1, NFA is proposed for SWMU no. 41-004.

8.6 Areas of Concern at OU 1098

There are five areas of concern (AOCs) identified for OU 1098, all of which are associated with TA-41. The areas are a sump, a 560-gal. diesel tank, an industrial waste tank (that may have never existed), storm drains, and a fuel tank of unknown origin. Investigation of AOC C-41-004, storm drains, is discussed in Section 7.17 of this work plan. Based on available information and data, the other four AOCs are recommended for NFA. Details leading to this decision are discussed below.

8.6.1 Sump (C-41-001)

According to the SWMU report on the AOC, the sump in question here is the sump already addressed in SWMU no. 41-003 (structure TA-41-10) (Figure 8.6-1). See Section 7.16 for further details. Engineering drawings and structure location maps show no other sumps for TA-41. This AOC is recommended for NFA, based on criterion 1, since there is no evidence that an AOC unique from SWMU no. 41-003 (which is being investigated) exists.

8.6.2 Diesel Tank (C-41-002)

According to Richard E. Larson (Larson 1992, 14-0001) a TA-41 site worker, the 560-gal. diesel tank is located to the south of the guard station TA-41-2 (Figure 8.6-1). The structure number on this tank is TA-41-W55, and it is an underground tank measuring 8 ft by 4 ft. The diesel is used to fuel a generator that is a back-up system for security lighting and an alarm system for TA-41. The tank was put into place in 1985 and is still active. Mr. Larson indicated that the tank has been leak tested in the past and at some time failed. The tank was dug up and the leak was found in the fuel stem. The tank was repaired and approximately 0.26 cu ft of soil around the tank were excavated. The tank was put back into place (McInroy 1992, 14-0006). The documentation of this activity has not been located. Subsequent leak tests have shown that the tank is tight, with a leak rate of 0.00163 gal./h (International Technology Corporation 1991, 14-0023). This AOC is recommended for NFA because the site was remediated and there is no evidence of more recent releases (NFA criterion 5).

8.6.3 Industrial Waste Tank (C-41-003)

The industrial waste tank, TA-41-W45, approximately 13 ft by 11 ft, was noted as located 50 ft southwest of Building TA-41-4 (Figure 8.6-1). This tank was noted as part of the new tritium facility that was built in the early 1950s (Laboratory Job no. 5783-41). Subsequent structure location maps from the

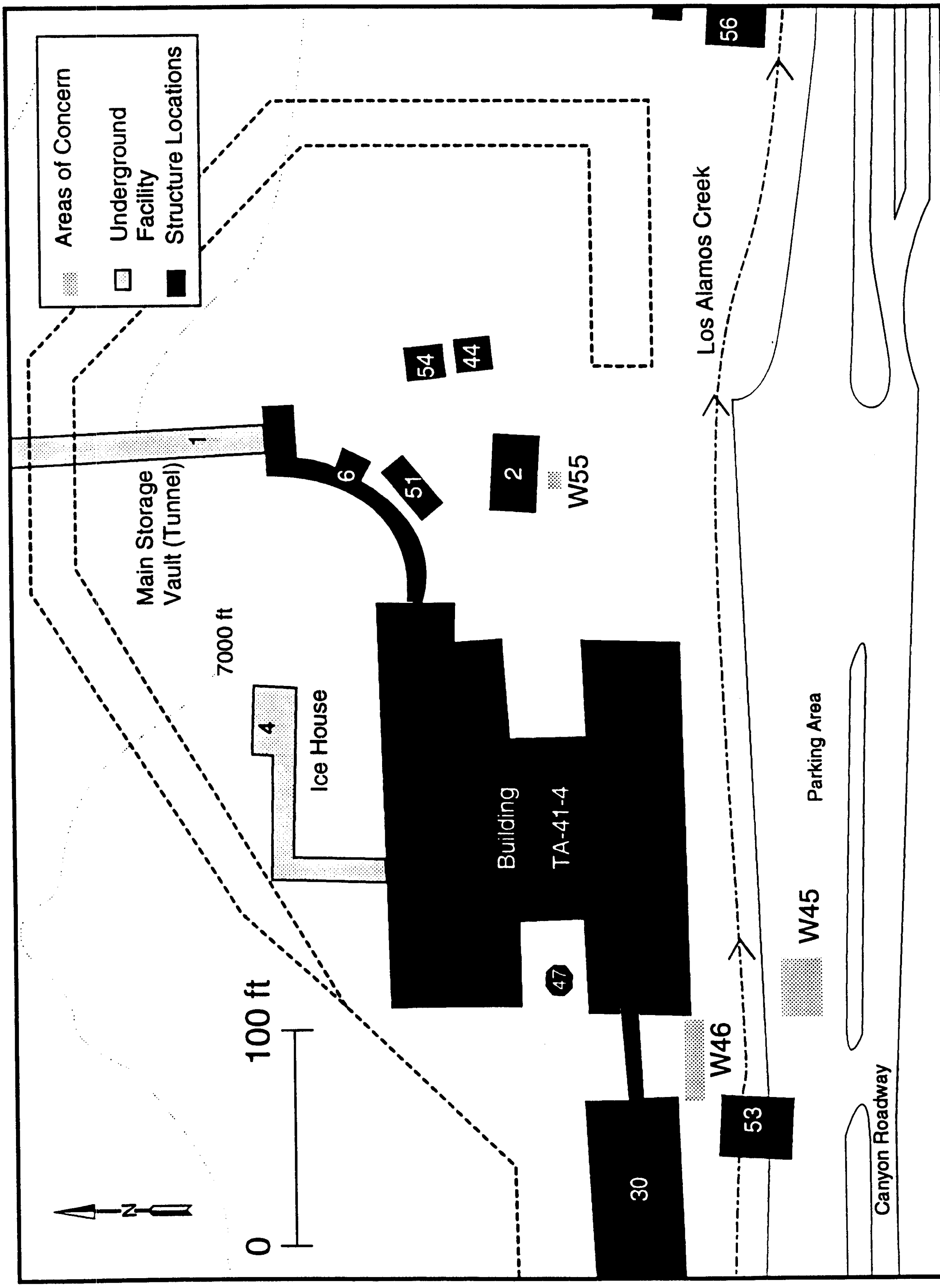


Figure 8.6-1 Location map of Areas of Concern.

1950s and 1960s for TA-41 do not identify this tank's location or acknowledge its existence. The tank was assigned a structure number in 1981, and on a 1983 structure location map the tank is listed with its structure number; however, its location is listed as unknown. Since the location and existence of this AOC are unknown, according to NFA criterion 1, this AOC is recommended for NFA.

8.6.4 Fuel Tank (C-41-005)

The fuel tank, TA-41-W46, is a 41 ft by 6 ft tank located 5 ft southwest of building TA-41-4 (Figure 8.6-1). The structure history notebook in Facilities Engineering Division, group ENG-7 describes this tank as a diesel fuel tank, associated with laboratory job number 5783-41. This is the same laboratory job number to which the industrial waste tank is associated. It was assigned a structure number in 1981, together with the industrial waste tank. The fuel tank's exact location is not documented on any engineering drawings, and it is unclear whether the tank ever existed. Since the location and existence of this AOC are unknown, according to NFA criterion 1, this AOC is recommended for NFA.

CHAPTER 8 REFERENCES

Bradley, W. A., October 23, 1992. Telephone interview with Rebecca Brown of Golder Associates, Los Alamos National Laboratory, Los Alamos, New Mexico. (Bradley 1992, 14-0004)

Gillespie, B. J., October 23, 1992. Telephone interview with Rebecca Brown of Golder Associates, Los Alamos National Laboratory, Los Alamos, New Mexico. (Gillespie 1992, 14-0005)

International Technology Corporation, October 1991. "Report on UST Integrity Testing, Los Alamos National Laboratory," Los Alamos, New Mexico. (14-0023)

LANL (Los Alamos National Laboratory), 1990. "Solid Waste Management Unit Report" (SWMU Report), Volumes I through IV, Los Alamos National Laboratory report LA-UR-90-3400, prepared by International Technology Corporation under contract 9-XS8-0062RF-1, Los Alamos, New Mexico. (LANL 1990, 0145)

Larson, R., October 6, 1992. Personal communication to P. Longmire (Los Alamos National Laboratory) from R. Larson, Los Alamos National Laboratory, Los Alamos, New Mexico. (Larson, Longmire 1992, 14-0001)

McInroy, D. J., October 27, 1992. Telephone interview with Rebecca Brown of Golder Associates, Los Alamos National Laboratory, Los Alamos, New Mexico. (McInroy 1992, 14-0006)

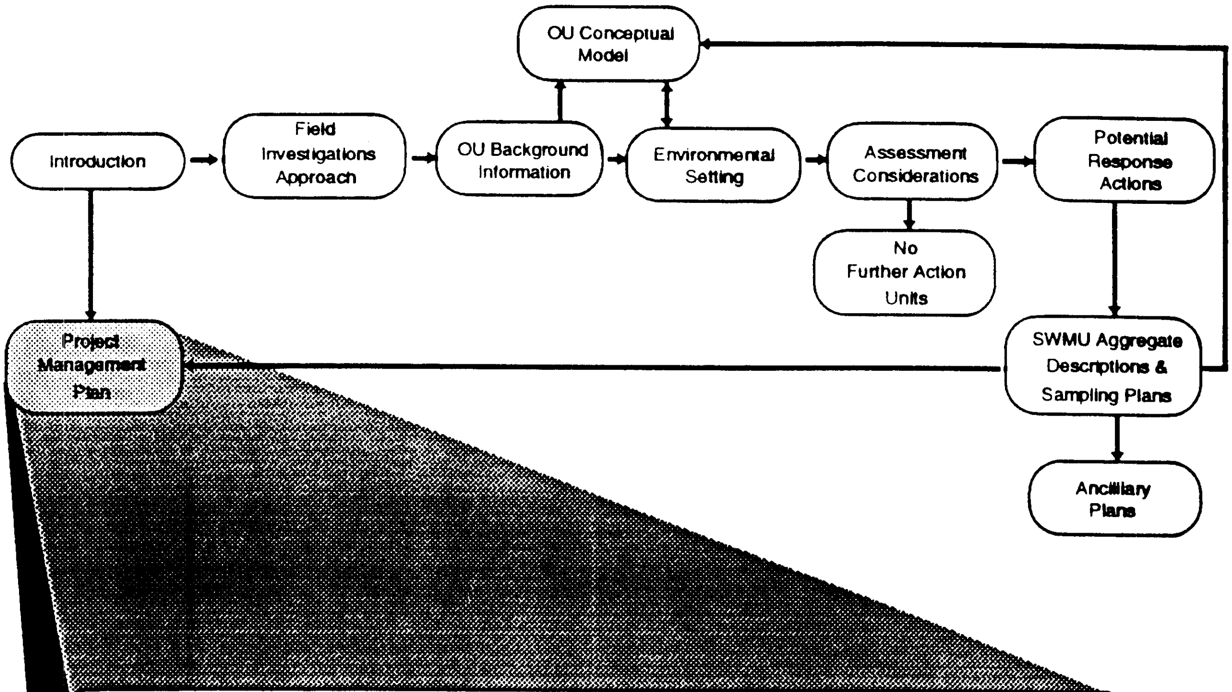
Mynard, C. R., October 23, 1992. Telephone interview with Rebecca Brown of Golder Associates, Los Alamos National Laboratory, Los Alamos, New Mexico. (Mynard 1992, 14-0007)

Penneman, R. A., 1992. Personal communication to P. Longmire, Los Alamos National Laboratory, Los Alamos, New Mexico. (Penneman 1992, 14-0003)

Penneman, R. A., September 17, 1992. Personal communication to P. Longmire, Los Alamos National Laboratory, Los Alamos, New Mexico. (Penneman 1992, 14-0009)

Thompson, L. B., 1945. "Cleanup Week at Omega," Los Alamos Scientific Laboratory memorandum to Charles Baker and John King, May 28, 1945. (Thompson 1945, 14-0033)

Annex I



Project Management Plan

- •Technical Approach
- •Schedule
- •Reporting
- •Budget
- •TA-2 and TA-41 OU Organization & Responsibility

PROJECT MANAGEMENT PLAN

PROJECT MANAGEMENT PLAN

This annex addresses the project management plan requirements of the HSWA Module (Task II, p.39) of the Laboratory's RCRA Part B Permit (EPA 1990, 0306) and presents the technical approach, management structure, schedule, budget, and reporting milestones for implementation of the TA-2 and TA-41 OU RFI as set forth in this work plan. The project management plan for the TA-2 and TA-41 OU RFI is an extension of the ER Program project management plan given in Annex I of the Installation Work Plan (IWP) (LANL 1991, 0553) and contains no significant departures from the IWP guidelines.

Figure EXEC-3 of the Executive Summary and Appendix A contain site diagrams and SWMU lists for the TA-2 and TA-41 OU.

I.1 Technical Approach

The approach used for the TA-2 and TA-41 OU is based on the ER Program's overall technical approach to the RFI/CMS process as described in Chapter 3 of the IWP (LANL 1991, 0553). The following key features characterize the ER Program approach:

- use of action levels as criteria to trigger a corrective measures study (CMS);
- phased sampling approach to site characterization;
- decision and cost effectiveness analysis to support the selection of remedial alternatives; and
- the application of the "observational" or "streamlined" approach to the RCRA Facility Investigation (RFI)/CMS process as a general philosophical framework.

The technical approach employed for the TA-2 and TA-41 OU RFI is described in Chapters 2 and 6 of this OU work plan. Figure I.1-1 contains a logic diagram for the TA-2 and TA-41 RFI. The general philosophy is to develop and iteratively refine the TA-2 and TA-41 OU conceptual model through carefully planned stages of investigation and data interpretation. The data gathered and subsequent interpretation will be used to define the nature and extent of contamination, and the likelihood for waste migration, at the TA-2 and TA-41 OU. An objective is to support interim corrective measures or a corrective measures study using the minimum data necessary.

The technical objectives of the TA-2 and TA-41 OU RFI, as presented in Chapters 5-7 of this OU work plan, are as follows:

- identify contaminants present at each SWMU;
- determine the vertical and lateral extent of the contamination at each SWMU;

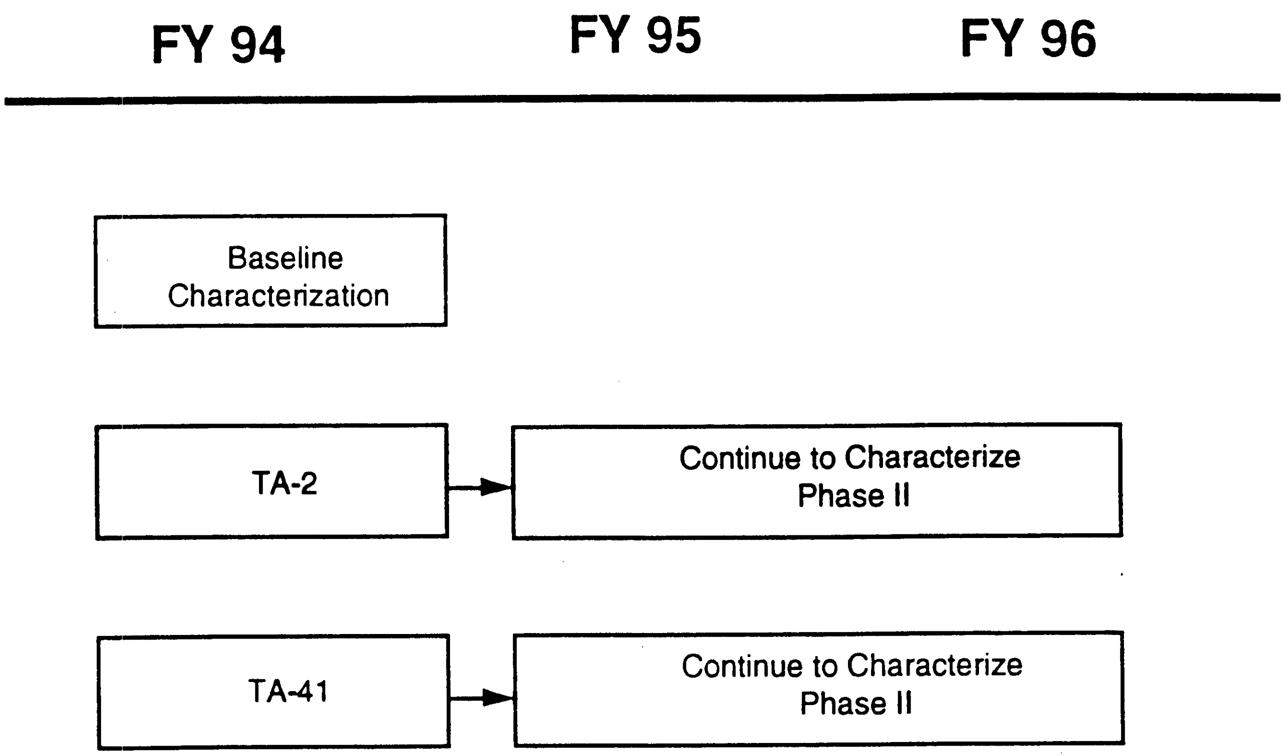


Figure I.1-1 Logic flow of the OU 1098 RFI.

- identify contaminant migration pathways;
- acquire sufficient information to allow quantitative migration pathway modeling and risk assessment;
- provide data necessary for the assessment of potential remedial alternatives; and
- provide the basis for detailed planning of corrective measures studies (CMS).

I.1.1 Technical Implementation Rationale

As summarized in this section, several relatively independent investigation paths comprise the schedule logic and the investigation rationale for the TA-2 and TA-41 OU RFI, listed as follows:

- SWMUs in areas of TA-2
- SWMUs in areas of TA-41
- Baseline characterization of Los Alamos Canyon (away from SWMU areas)
- Borehole characterization

Investigations of SWMUs in areas of TA-2

Investigations of SWMUs located in areas of TA-2 are described in Sections 7.4 through 7.13 of this OU work plan. The characterization studies are designed primarily to determine whether contaminants exist above levels of concern in these areas. Phase I and II investigations requiring about three years of field work to complete is expected to be required for these areas. The RFI is expected to lead to recommendations of remedial action for some of these SWMUs, because the potential for significant contamination at some SWMUs is likely to be demonstrated. No further action is recommended for three SWMUs based on criteria presented in Chapter 8.

Investigations of SWMUs in areas of TA-41

Phase I and II investigations of TA-41 are described in Sections 7.14 through 7.17 of this OU work plan. These investigations primarily are designed to delimit the contaminated surface and subsurface areas potentially existing at TA-41. Characterization of transport-related properties of TA-2 and TA-41 soils also is proposed. Approximately one year of field work (within the three-year window) is expected to be required for Phase I investigations at TA-41. Contingent upon the results of Phase I, Phase II investigation could be required which may or may or not suggest a subsequent CMS.

Baseline Characterization (away from SWMU areas)

In Section 7.1 of this OU work plan, Phase I baseline characterization is proposed which consists of the following elements:

- Analysis of a number of soil and sediment samples not impacted from known TA-2 and TA-41 SWMUs to define site background levels and to evaluate contaminant mobility within Los Alamos Canyon (TA-21)
- Surface and subsurface geologic characterization of site stratigraphy, structure, drainage, and erosional characteristics
- Development of geochemical and hydrogeologic base maps addressing surface and subsurface contaminant mobility, sorptive characteristics of soils, sediments, Bandelier Tuff and other volcanic flow units, stratigraphic sections, bvc geomorphology, hydrology, and joint/fracture information.

This work will be conducted at various levels of intensity over the three-year period of Phase I investigations. It is not anticipated that Phase II studies will be required for baseline investigations.

Characterization Well/Borehole Monitoring

Quarterly sampling of the existing monitor wells LAO-C, LAO-1, LAO-2, LAO-3, LAO-4, LAO-4.5, TW-3, Otowi-4, and the proposed additional characterization wells will be performed for three years. Annual sampling of all monitor wells will be continued indefinitely by EM-8. Neutron moisture measurements will be carried out on a quarterly basis Phase I in boreholes as specified in Chapter 7 of this OU work plan. Water levels in all characterization wells will be measured continuously during Phase I and Phase II.

I.1.2 Priorities

The management priorities for the TA-2 and TA-41 RFI are as follows:

- TA-2 probably contains by far the largest inventory of contaminants within the OU and is the most likely area to require a second phase of investigation, and possibly a CMS. Therefore, the primary focus of the TA-2 and TA-41 RFI/CMS is on OWR and work at this area should receive preferential scheduling and funding.
- Characterization of alluvial, perched (potential), and main aquifers should receive the highest priority in the investigations conducted at TA-2 and TA-41.
- Some TA-41 SWMUs are likely to contain contaminants above levels of concern. Therefore, the investigation of TA-41 is second in priority only to that of TA-2.

- Except for groundwater monitoring as mentioned above, the proposed baseline characterization can be carried out at any time during Phase I and Phase II.

I.2 Schedule

General schedule requirements for the Laboratory's ER program are described in Annex I (Program Management Plan) of the IWP. Appendix S of the IWP contains a projected RFI/CMS schedule for the RFI/CMS process for the TA-2 and TA-41 OU, through the completion of the final CMS report. A revised version of this schedule was completed recently as Activity Data Sheet (ADS) 1098 and was submitted on April 1, 1993 for incorporation in the DOE Environmental Restoration and Waste Management Five-Year Plan. This plan is a key budget planning document for the DOE-wide ER program. The projected RFI/CMS schedule, milestone schedule, and baseline (unconstrained) budget summary submitted recently to DOE for the TA-2 and TA-41 RFI (ADS 1098) are provided in Tables EXEC-5 and I.1-1 and Figures EXEC-3 and I.2-1 of this OU work plan. Table I.1-2 contains a detailed projected schedule for the TA-2 and TA-41 RFI/CMS, based on the unconstrained Five-Year Plan budget/schedule.

Implementation of RFI activities is contingent upon regulatory review and approval of the TA-2 and TA-41 OU Work Plan and upon the availability of funding. If the detailed costing of this OU work plan exceeds the planned budget, budgetary resolution will have to be accomplished either by a petition to DOE for additional funding through a change-control procedure or by extension of the RFI schedule. Schedules and costs will be updated through the DOE change control process as appropriate, with revisions submitted to EPA for approval.The assumptions used to generate this schedule include the following:

- Review and approval of the TA-2 and TA-41 OU RFI work plan and supporting project plans by regulatory agencies will be completed by August, 1993.
- Certain tasks (e.g., baseline and Los Alamos Canyon characterization) may be initiated before regulatory agencies grant final approval of the work plan.
- The schedule assumes that an adequate number of support personnel (e.g., HSE technicians and trained drilling contractors) will be available.
- EPA approval of technical memoranda/work plan modifications (including EPA comments, Laboratory revision, and final EPA approval) is assumed to take two months, of which one month is allowed for EPA review and comment, and one month for revisions.
- Phase II investigations are expected to be required only at TA-2.

- The Phase I work scheduled in the first investigation year (1994) is constrained by the current planned DOE budget.
- Where possible, extensive field work will not be scheduled between November 15 and March 15 each year, to allow for inclement weather.

I.3 Reporting

Results of RFI field work will be presented in three principal documents: quarterly technical progress reports, phase reports/work plan modifications, and the RFI Report. The purpose of each of these reports is detailed in the following discussion. A schedule of future documents, associated with implementation of this OU work plan, which are deliverable to EPA and DOE is summarized in Table EXEC-2 this OU work plan and in the following list.

Document	EPA	DOE	Date Due
Monthly	X	X	25th of the following month
Quarterly	X		Feb. 15, May 15, & Aug. 15
Annual	X	X	Nov. 15
Phase Reports	X	X	as in baseline; DOE milestones

I.3.1 Quarterly Technical Progress Reports

As the TA-2 and TA-41 OU RFI is implemented, technical progress will be summarized in quarterly technical progress reports, as required by the HSWA module of the Laboratory's RCRA Part B operating permit (Task V, C, page 46). Detailed technical assessments will be provided in technical memoranda/work plan modifications.

I.3.2 Technical Memoranda/Work Plan Modifications

Technical memoranda/work plan modifications will be submitted for work conducted on TA-2 and TA-41 SWMUs. These documents will function as interim reports on portions of the RFI effort because of the multi-year time frame which will be required for completion of RFI field work. In other words, these technical memoranda will serve as partial RFI Phase I reports summarizing the results of initial site characterization activities and as partial RFI Phase II work plans describing the follow-on activities being planned (including any modifications to field sampling plans suggested by initial findings).

I.3.3 RFI Report

The RFI report for the TA-2 and TA-41 OU will summarize all field work conducted during the RFI. As required by the HSWA module of the Laboratory's RCRA Part B operating permit, the Laboratory will submit an RFI report within 60 days of completion of the RFI. As stated in Chapter 3 of the IWP (LANL 1992, 0768), the RFI Report will describe the procedures, methods, and results of field investigations and will include information on the type and extent of contamination, sources and migration pathways, and actual and potential receptors. The report also will contain adequate information to support delisting of sites that require no further corrective action.

I.4 Budget

The schedule presented above is based on constrained budgets for the first two years of the RFI and preliminary cost analysis which is subject to significant uncertainties. The projected budget in fiscal year 1994 (FY 94) is based on expected DOE funding levels and is subject to change depending upon funding allocations actually made. A change control petition to DOE is required to augment these funding levels. Because DOE funding requests are set two years in advance, the first year in which the TA-2 and TA-41 OU RFI is not constrained by previous budget estimates will be FY 95. Funding requests for FY 95 and beyond will reflect the cost and schedule that most efficiently complete the RFI plans.

As pointed out above, the costing is being refined and is subject to considerable uncertainties at the present time. In particular, uncertainties regarding the extent of groundwater contamination, including the cost of drilling through potentially contaminated areas, could impact RFI costs substantially.

I.5 TA-2 and TA-41 OU Organization and Responsibility

The organizational structure for the ER Program is presented in Chapter 2 of the generic LANL ER Program Quality Program Plan and Quality Assurance Project Plan (QPP/QAPjP). ER Program personnel authority and responsibilities are identified in this document and in Figures I.5-1 and I.5-2 of this annex.

Records of qualifications and training of all field personnel working on the RFI for the TA-2 and TA-41 OU will be kept as ER Records [see Annex IV of the IWP, Records Management Plan]. Technical Contributors to the TA-2 and TA-41 work plan are listed in Appendix H of this OU work plan.

The responsibilities of the positions identified in Figures I.5-1 and I.5-2 and are summarized in the following subsections.

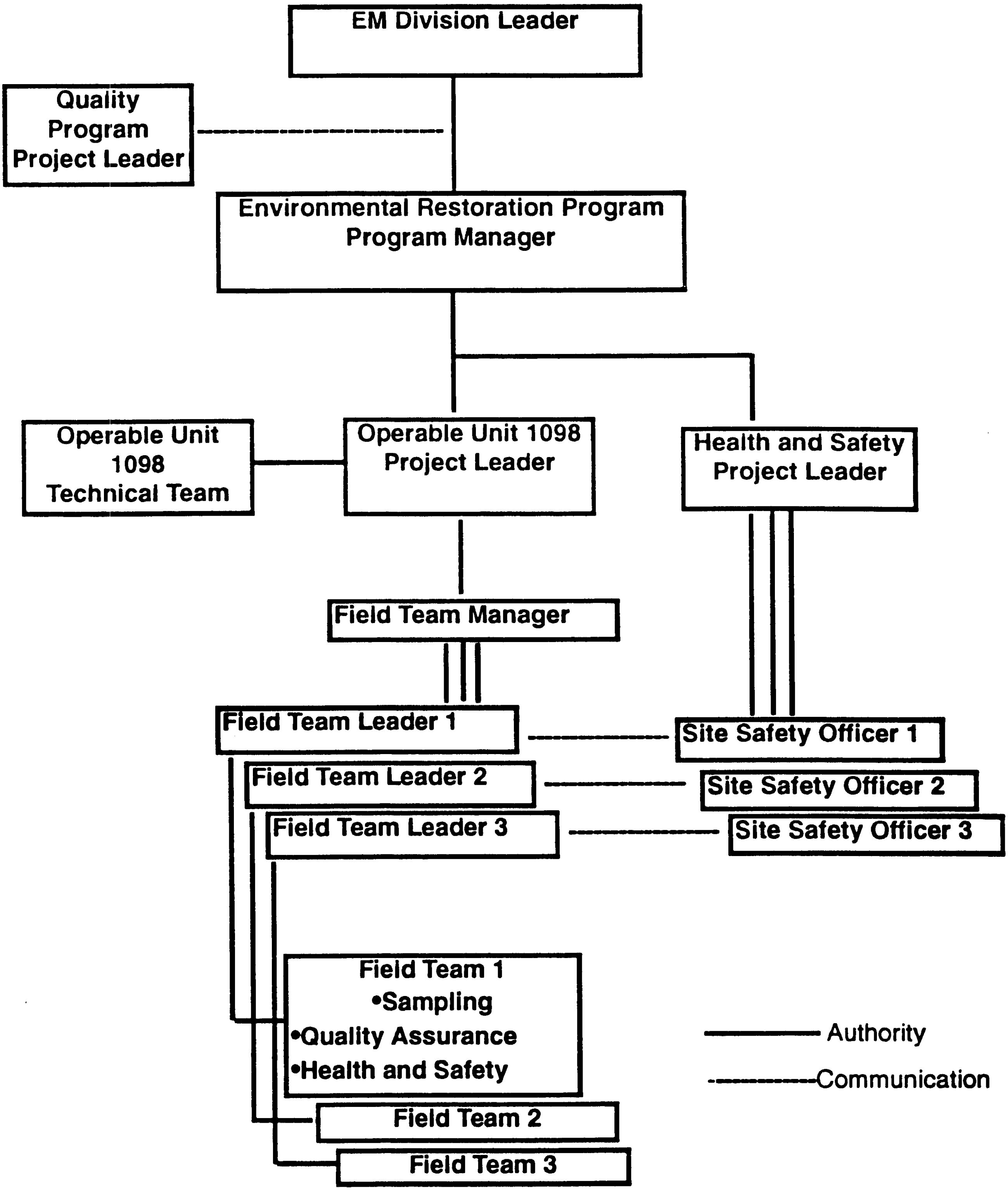


Figure I.5-1 Operable Unit 1098 field work organization chart showing lines of authority and responsibility

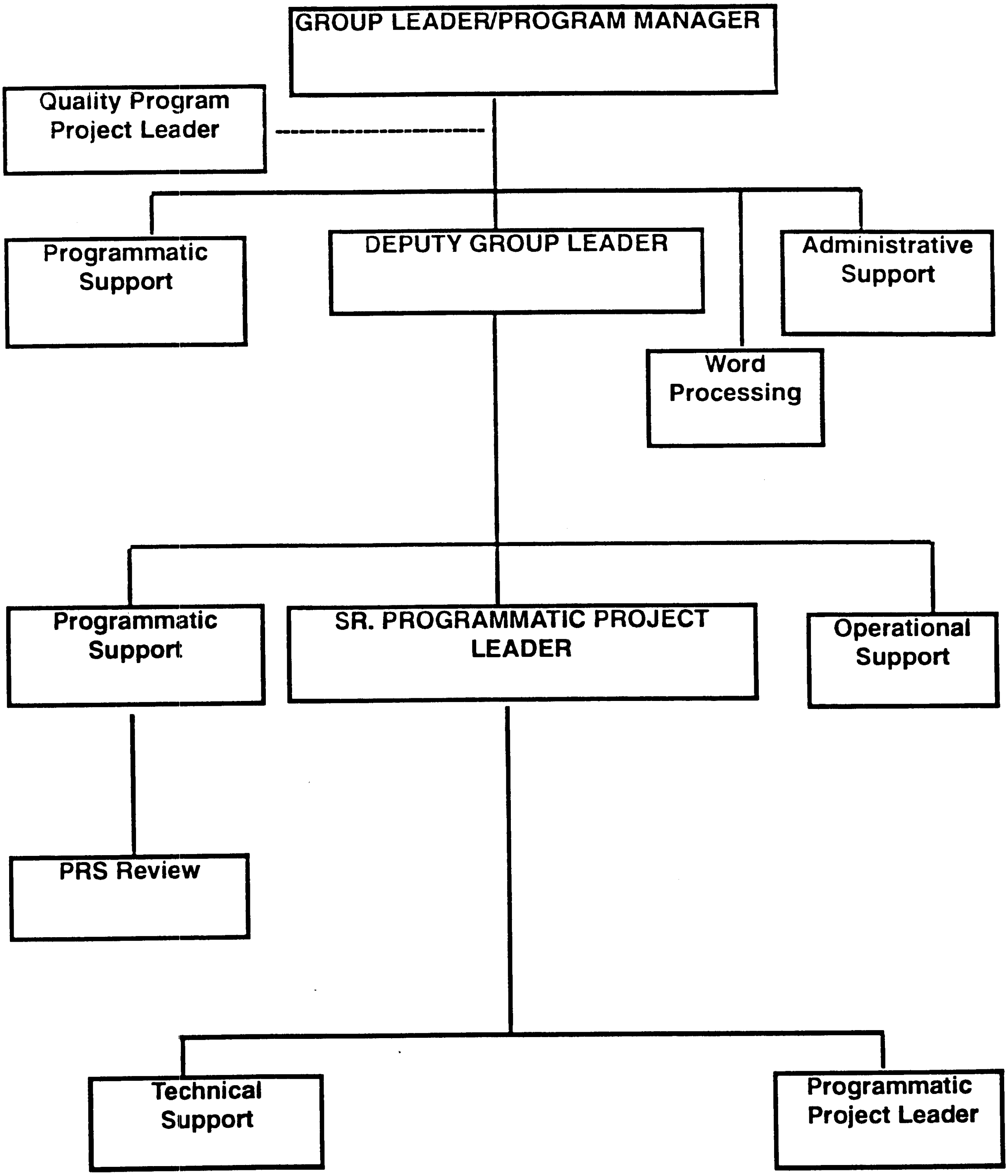


Figure I.5-2 Laboratory ER Program organizations

OU Project Leader

Responsibilities of the TA-2 and TA-41 OU Project Leader are as follows:

- oversees day-to-day RFI operations, including planning, scheduling, and reporting technical and related administrative activities;
- ensures preparation of scientific investigation planning documents and procedures;
- prepares monthly and quarterly reports for the Project Manager (PM);
- oversees subcontractors, as appropriate;
- coordinates with technical team leaders and conducts technical reviews of the milestones and final reports;
- Interfaces with the ER Quality Program Project Leader (QPPL) to resolve quality concerns and to coordinate with the QA staff for audits;
- complies with the LANL ER Program Health and Safety (H&S), records management, and community relations requirements;
- oversees RFI field work and manages the field teams manager; and
- complies with the Laboratory's technical and QA requirements for the LANL ER Program.

I.5-2 Technical Team Members

Technical team members are responsible for providing technical input for their discipline throughout the RFI/CMS process. Technical team members have participated in the development of the TA-2 and TA-41 OU work plan and the individual field sampling plans and will continue to participate in the field work, data analysis, report preparation, work plan modifications, and planning of subsequent investigations as necessary.

The primary disciplines currently represented on the TA-2 and TA-41 OU technical team are risk assessment, chemistry, geology, hydrology, geochemistry, statistics, biology, archeology, and health physics. The composition of the technical team may change with time as the technical expertise needed to implement the TA-2 and TA-41 OU RFI changes.

I.5-3 Field Teams Manager

Responsibilities of the TA-2 and TA-41 OU Field Teams Manager include the following:

- conducts detailed planning and scheduling for the implementation of the RFI field activities outlined in Chapter 6
- oversees day-to-day field operations; and
- manages field team activities.

1.5-4 Field Team Leader(s)

The Field Teams Manager will assign field work to Field Team Leaders for implementation in the field. Each Field Team Leader will direct the execution of field sampling activities, using crews of field team members as appropriate for the activity. Field Team Leaders may be Laboratory or contractor personnel.

1.5-5 Field Team Member(s)

Field Team Members include the following, as appropriate:

- sampling personnel,
- site safety officer,
- geologists,
- hydrologists,
- health physicists, and
- other applicable disciplines.

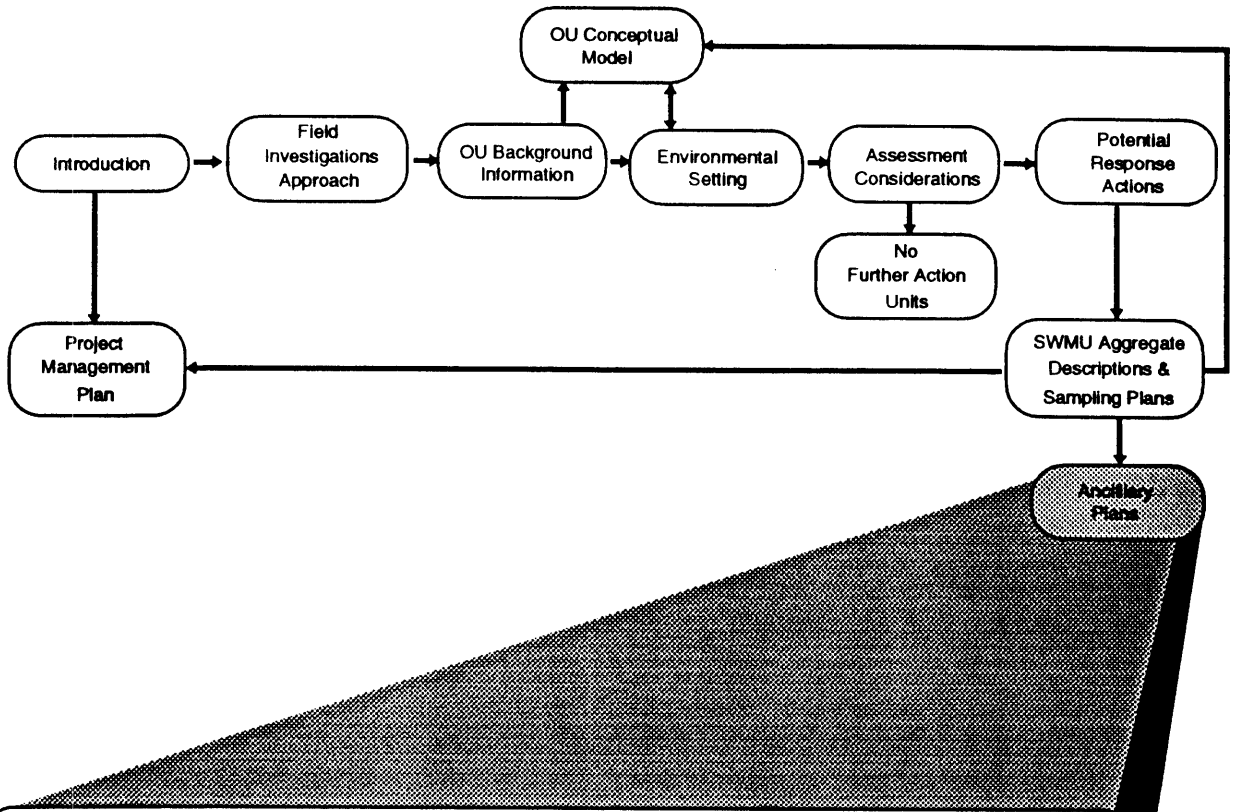
All teams will have, at a minimum, a site safety officer and a qualified field sampler. They are responsible for conducting the work detailed in field sampling plans, under the direction of the field team leader. Field team members may be Laboratory or contractor personnel.

Annex I References

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

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

Annex II



Quality Assurance Project Plan

SIGNATURE PAGE

Approval for Implementation

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

   SIGNATURE:______________________________ **DATE:** __________

2. **NAME:** A.E. Norris
   TITLE: Quality Assurance Project Leader, ER Program, Los Alamos National Laboratory

   SIGNATURE:______________________________ **DATE:** __________

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

   SIGNATURE:______________________________ **DATE:** __________

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

   SIGNATURE:______________________________ **DATE:** __________

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

   SIGNATURE:______________________________ **DATE:** __________

6. **NAME:** Alba L. Smith
   TITLE: Chief of Office of Quality Assurance, Region VI, Environmental Protection Agency

   SIGNATURE:______________________________ **DATE:** __________

7. **NAME:** Pat A. Longmire INC-9
   TITLE: Project Leader, Isotope and Nuclear Chemistry, Los Alamos National Laboratory

   SIGNATURE:______________________________ **DATE:** __________

QUALITY ASSURANCE PROJECT PLAN

for

Operable Unit

1098

Los Alamos National Laboratory

Environmental

Restoration

Program

May 1993

TABLE OF CONTENTS

1.1 List of Tables

LIST OF ACRONYMS

AP	Administrative Procedure
DQOs	Data Quality Objectives
EM	Environmental Management
EPA	US Environmental Protection Agency
ER	Environmental Restoration
ES	Earth Sciences
FTL	Field Team Leader
HSPL	Health and Safety Project Leader
IWP	Installation Work Plan
LANL	Los Alamos National Laboratory
OU	Operable Unit
OUPL	Operable Unit Project Leader
PQL	Practical Quantitation Limit
PRSs	Potential Release Sites
QA	Quality Assurance
QAPjP	Quality Assurance Project Plan
QC	Quality Control
QP	Quality Procedure
QPP	Quality Program Plan
QPPL	Quality Program Project Leader
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facilities Investigation
SCF	Sample Coordination Facility
SOP	Standard Operating Procedures
SOW	Statement of Work
SS	Subsurface Studies
TAs	Technical Areas
TBD	To be determined
TCLP	Toxicity Characteristic Leaching Procedure
TTL	Technical Team Leader

PROJECT DESCRIPTION

3.1 Introduction

This quality assurance (QA) project plan (QAPjP) provides specific instructions to Los Alamos National Laboratory (LANL) and its contractors to help assure that the work performed during the Operable Unit (OU) 1098 Resource Conservation and Recovery Act (RCRA) Facilities Investigation (RFI) will be of the quality required to satisfy project objectives. This plan addresses the 16 essential elements presented in the US Environmental Protection Agency (EPA) document "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans" (QAMS-005/80) (EPA 1980, 0552). This document is tiered to LANL's Generic Quality Project Plan (QAPjP) for RFIs (LANL 1992, 0782).

3.2 Facility Description

A facility description of LANL and descriptions of individual areas are presented in Section 2.0 of the LANL ER Program Installation Work Plan (IWP) (LANL 1992, 0768).

3.3 Environmental Restoration Program

A description of the ER Program is presented in Section 3.0 of the IWP (LANL 1992, 0768).

3.4 Project Description

OU 1098 incorporates Technical Areas (TAs) -2 and -41. Since the establishment of TA-2 in 1943, several types of nuclear reactors have been operated on the site. TA-2 is presently the site of the Omega West Reactor (OWR), an eight-megawatt, water-cooled research nuclear reactor fueled by highly enriched uranium contained in solid fuel elements. Two prior reactors at TA-2 included a decommissioned plutonium-fueled, mercury-cooled reactor known as Clementine, and the Water Boiler Reactor, a homogeneous liquid-fueled reactor containing enriched uranium-235 dissolved as a uranyl salt solution.

Technical Area-41 has been used for developing weapon subsystems and conducting long-term studies on weapon subsystems. There are also offices and shop facilities at TA-41.

Preliminary investigations of the OU conducted in 1987 revealed 17 Potential Release Sites (PRSs) that warranted more detailed investigation. Most of these PRSs are associated with operations at TA-2. In most cases, potential contaminants in OU 1098 include fission products associated with the OWR and Water Boiler operations, plutonium and mercury from Clementine operations, and chromium from OWR cooling tower drift loss. A few of the PRSs also have additional inorganic and organic constituents as potential contaminants of concern. More complete descriptions of the OU 1098 PRS are included in the RFI Work Plan.

3.4.1 Project Objectives

The comprehensive project objectives are described in Chapter 2 of the RFI Work Plan. Specific project objectives for each PRS to be investigated are presented in Chapter 7 and 8 of the RFI Work Plan.

3.4.2 Project Schedule

The anticipated project schedule is provided in the Executive Summary of the RFI Work Plan.

3.4.3 Project Scope

The scope of the OU 1098 RFI is given in Chapter 2 of the RFI Work Plan.

3.4.4 Background Information

The background information is given in Chapter 3 of the RFI Work Plan and the environmental setting is given in Chapter 4 of the RFI Work Plan.

3.4.5 Intended Data Uses

The intended data uses are described in Chapter 6 of the RFI Work Plan.

4.0 Project Organization and Responsibility

The overall organizational structure of the of the Environmental Restoration (ER) Program is presented in Section 2 of the LANL QPP (Annex II of the IWP) (LANL 1992, 0768). A complete description of the responsibilities under this organizational structure can be found in Annex I of the RFI Work Plan.
Primary project assignments and telephone contact numbers are as follows:

- Operable Unit Project Leader (OUPL): Pat Longmire; (505) 665-8572
- Quality Program Project Leader (QPPL): Ted Norris; (505) 665-4677
- Health and Safety Project Leader (HSPL): Susan Alexander; (505) 667-5722 or (505) 104-3283
- Technical Team Leader (TTL): To be determined

- Field Team Manager (FTM): To be determined
- Field Team Leaders (FTL): To be determined
- Field Team Members: To be determined

The QA responsibilities of OU 1098 project team members are described in the following subsections. Brief descriptions of the education and relevant experience of the OU 1098 RFI personnel are provided in Appendix H of this RFI work Plan. The responsibilities described for each team member can be delegated by that team member to other qualified individuals as required to meet project demands.

4.1 Operable Unit Project Leader

The OUPL for OU 1098:

- oversees day-to-day operations, including planning, scheduling and reporting technical and related administrative activities;
- ensures preparation of planning documents and procedures for conducting scientific investigations;
- ensures that the OU 1098 project complies with applicable environmental regulations, DOE orders, University of California and LANL policy, and applicable New Mexico laws and regulations;
- prepares monthly and quarterly reports for the program manager;
- oversees subcontractors, as appropriate;
- coordinates with TTLs;
- conducts technical reviews of milestones and final reports;
- interfaces with the QPPL to resolve quality concerns and to coordinate audits with the QA staff;
- complies with the ER Program's health and safety, field sampling, and records management procedures;
- oversees the OU 1098 field work, manages the FTL and other field team members, and issues programmatic guidance to team members;
- complies with the technical and QA requirements for the LANL ER Program.

The OUPL will assign work for the OU 1098 RFI through the use of specific written scopes of work for both subcontractors and internal LANL personnel and groups. The assignment of work to subcontractors will be controlled through the LANL procurement procedures. The assignment of work within LANL will be controlled through the use of the internal statement of work (SOW).

As required by the internal SOW procedure, internal work will only be assigned after a completed SOW is provided to the OUPL in response to the detailed scope of work. Section II of the SOW provides documentation of responsibilities for the OU 1098 RFI activities. Copies of the completed SOW will be provided to the OUPL, and Section II of the SOW will be provided to the people to which the work has been assigned. If any additional personnel are assigned after the SOW has been completed, Section II of the SOW must be completed for each additional person.

4.2 Quality Program Project Leader

The QPPL for OU 1098:

- ensures that the quality program is properly implemented;
- ensures that independent organizations adequately and effectively evaluate the quality program;
- verifies that ER Program personnel and subcontractors properly implement the ER Quality Program;
- oversees the OU 1098 QA staff;
- resolves disputes and issues stop-work orders regarding quality;
- reviews and approves quality-related plans and implementing procedures;
- conducts QA audits, reviews, and surveillance;
- coordinates QA audits with the OUPL; and
- prepares monthly QA reports to the ER Program Manager.

The QPPL functions in parallel with the OU 1098 project. The QPPL reports directly to the ER Program Manager on day-to-day activities and to the Environmental Management (EM) division leader when necessary to resolve QA issues.

4.3 Health and Safety Project Leader

The HSPL for OU 1098:

- ensures that the OU 1098 Health and Safety Plan is properly implemented;
- reviews and approves site-specific Health and Safety Plans prepared for OU 1098;

- informs the OUPL and FTL of health and safety issues;
- ensures that the OU 1098 project complies with applicable health and safety aspects of environmental regulations, DOE orders, University of California and LANL policy, and applicable New Mexico laws and regulations; and
- oversees the OU 1098 Health and Safety staff.

4.4 Technical Team Leaders

The TTLs for OU 1098:

- provide technical input for appropriate disciplines throughout the RFI/CMS process;
- participate in field work, data analysis, report preparation, work plan modifications, and planning of subsequent investigations as necessary.

The composition of the technical team may change with time as the technical expertise needed to implement the OU 1098 RFI changes.

4.5 Field Team Manager

The FTM for OU 1098:

- oversees daily field operations, including planning, scheduling, and implementing field activities for OU 1098;
- manages day-to-day field team activities;
- coordinates field team activities with the OUPL; and
- ensures the quality and completeness of field team deliverables.

4.5.1 Field Team Leader(s)

The Field Team Leader(s) (FTLs) for OU 1098:

- receive assignments from the Field Team Manager for implementation in the field;
- direct the execution of field sampling activities, using crews of field team members as appropriate for the activity.

4.5.2 Field Team Members

The field team members will include, depending on the activity being conducted, a site safety officer, appropriate subcontractors, sampling personnel, and staff members with technical knowledge of geology, hydrology, statistics, chemistry, and other applicable disciplines. The field team members comply with the ER Program's technical, administrative, and QA procedures as described in this QAPjP, and with the directions given by the TTLs, FTL, and OUPL.

5.0 Quality Assurance Objectives for Measurement Data

The QA objectives for measurement data are expressed in terms of the precision, accuracy, representativeness, completeness, and comparability of the data. The precision, accuracy, and completeness objectives for the OU 1098 RFI are based on the criteria specified in Section 5.0 of the Generic QAPjP. The analytical methods that will be used for the OU 1098 analyses are based on EPA methods, when available, or other methods of generally recognized by Los Alamos National Laboratory and accepted institutions such as the American Society for Testing and Materials.

The overall QA objective is to develop and implement procedures that will help ensure quality in field sampling, field testing, chain-of-custody, laboratory analysis, data validation, data analysis, and data reporting. Specific procedures for sampling, chain-of-custody, audits, preventive maintenance, and corrective action are described in other sections of this QAPjP or in specific procedures referenced by this QAPjP. This section defines the goals for accuracy, precision, completeness, representativeness, and comparability. QA goals for field measurements are also discussed.

5.1 Level of Quality Control

The levels of quality control (QC) described in Section 5.1 and Tables V.1 and V.2 of the Generic QAPjP will be used for the OU 1098 RFI with one exception; reagent blanks will not be collected as field QC samples because the use of reagents in the field will be limited to preservation reagents that will also be added to the rinsate blanks. The DQOs for the OU 1098 RFI can be met without the use of reagent blanks.

5.2 Precision, Accuracy, and Sensitivity of Analyses

The precision, accuracy, and sensitivity of the laboratory analytical data will be equivalent to or appropriate to site-specific conditions of samples collected at OU 1098 the limits provided in Tables V.3 through V.12 of the Generic QAPjP. The sensitivity requirements provided in the Generic QAPjP have been changed for selected OU 1098 RFI analytes in order to address the screening action levels specified in Appendix J of the IWP (LANL 1992, 0768). These screening action levels and the required sensitivity for each analyte included in the OU 1098 RFI are listed in Tables 5.1 and 5.2 of this QAPjP. Tables 5.1 and 5.2 also list suggested analytical methods capable of meeting the present screening

Table 5.1
OU 1098 SAMPLING PARAMETERS

Contaminant	Present Screening Action Level[a]		Practical Quantitation Limit[b]		Analytical Method	
	Water (pCi/l)	Soil (PCi/g)	Water (pCi/l)	Soil (pCi/g)	Water	Soil
Radiological Parameters						
Gross alpha	15[c]	TBD[d]	5.0	10	(b)	(b)
Gross beta	50[c]	TBD[d]	6.0	12	(b)	(b)
Cesium-137	TBD[d]	4	20	0.1	(b)	(b)
Strontium-90	TBD[d]	8.9	3.0	2.0	(b)	(b)
Technetium-99	TBD[d]	TBD[d]	TBD[e]	TBD[e]	(b)	(b)
Total Uranium	100	240	2.0	0.5	(b)	(b)
Isotopic Plutonium (includes Pu-238 and Pu-239)	TBD[d]	51	0.04	0.005	(b)	(b)
Cobalt-60	TBD[d]	0.9	300	2.0	(b)	(b)
Tritium	20000[c]	TBD[d]	400	400	(b)	(b)
Organics						
Total Petroleum Hydrocarbons	TBD[d]	TBD[d]	500	50	8015	8015
Volatile Organics[f]	f	f	f	f	f	f
Semivolatile Organics[f]	f	f	f	f	f	f
Pesticides/PCBs[f]	f	f	f	f	f	f
Inorganics						
Metals[f]	f	f	f	f	f	f

a Source: LANL 1992, 0768, Appendix J. Screening action level criteria in effect at the time of sampling will be used in analyzing the data from Phase I activities.

b Source: LANL, May 1991. "Generic Quality Assurance Project Plan," Los Alamos National Laboratory, Los Alamos, New Mexico (LANL 1991, 0553). Practical Quantitation Limits are given in picoCuries per liter for water and picoCuries per gram for soil, except for total uranium and total petroleum hydrocarbons, which are in milligrams per liter for water and milligrams per kilogram for soil, and tritium which is in picoCuries per liter for both water and soil.

c Maximum contaminant level (MCL) promulgated under the Safe Drinking Water Act.

d To be determined. Screening action level criteria were not available at the time of Work Plan preparation.

e To be determined. Method not specified in Generic QAPjP.

f The specific contaminants and the associated limits for these parameters are listed in Table 5.2.

Table 5.2
APPENDIX IX SAMPLING PARAMETERS

Contaminant	Present Screening Action Level[a]		Practical Quantitation Limit[b]		SW 846 Analytical Method[c]	
	Water (mg/l)	Soil (mg/kg)	Water (mg/l)	Soil (mg/kg)	Water	Soil
Volatile Compounds						
Acetone	3.5	8000	0.10	0.10	8240	8240
Acetonitrile	TBD[d]	TBD[d]	0.10	0.10	8240	8240
Acrolein	TBD[d]	TBD[d]	0.005	0.005	8240	8240
Acrylonitrile	TBD[d]	TBD[d]	0.005	0.005	8240	8240
Allyl chloride	TBD[d]	TBD[d]	0.005	0.005	8240	8240
Benzene	0.001	0.67	9.0E-5	9.0E-5	8021	8021
Bromodichloromethane	2.7E-4	5.4	2.0E-4	2.0E-4	8021	8021
Bromoform	0.0044[e]	89	0.005	0.005	8240	8240
Carbon disulfide	3.5	7.4	0.10	0.10	8240	8240
Carbon tetrachloride	2.7E-4	0.21	1.0E-4	1.0E-4	8021	8021
Chlorobenzene	0.1	67	0.005	0.005	8240	8240
Chloroethane	TBD[d]	3300	0.01	0.01	8240	8240
Chloroform	0.0057	0.21	2.0E-4	2.0E-4	8021	8021
Chloroprene	TBD[d]	TBD[d]	0.005	0.005	8240	8240
Dibromochloromethane	0.0042	83	3.0E-4	3.0E-4	8021	8021
1,2-Dibromo-3-chloropropane	TBD[d]	TBD[d]	0.03	0.03	8021	8021
1,2-Dibromoethane	TBD[d]	TBD[d]	0.005	0.005	8240	8240
trans-1,4-Dichloro-2-butene	TBD[d]	TBD[d]	0.10	0.10	8240	8240
Dichlorodifluoromethane	TBD[d]	TBD[d]	5.0E-4	5.0E-4	8021	8021
1,1-Dichloroethene	5.8E-4[e]	0.59	7.0E-4	7.0E-4	8021	8021
1,2-Dichloroethane	3.8E-4	0.2	3.0E-4	3.0E-4	8021	8021
1,1-Dichloroethane	3.5	410	0.005	0.005	8240	8240
trans-1,2-Dichloroethene	0.1	800	0.005	0.005	8240	8240
1,2-Dichloropropane	5.1E-4	10	6.0E-5	6.0E-5	8021	8021
cis-1,3-Dichloropropene	1.9E-4[e]	0.17	0.005	0.005	8240	8240
trans-1,3-Dichloropropene	1.9E-4[e]	0.17	0.005	0.005	8240	8240
1,4-Dioxane	TBD[d]	TBD[d]	0.15	0.15	8240	8240
Ethylbenzene	0.7	3100	0.005	0.005	8240	8240
Ethyl methacrylate	TBD[d]	TBD[d]	0.005	0.005	8240	8240
Hexachlorobutadiene	4.5E-3	90.0	6.0E-4	4.0E-2	8021	8021
2-Hexanone	TBD[d]	TBD[d]	0.05	0.05	8240	8240
Isobutyl alcohol	TBD[d]	TBD[d]	0.10	0.10	8240	8240
Methacrylonitrile	TBD[d]	TBD[d]	0.10	0.10	8240	8240
Methyl bromide	0.049	0.43	0.010	0.010	8240	8240
Methyl chloride	0.027	6.4	0.010	0.010	8240	8240
Methylene bromide	TBD[d]	TBD[d]	0.005	0.005	8240	8240
Methylene chloride	0.0047	5.6	2.0E-4	2.0E-4	8021	8021

Table 5.2 (continued)
APPENDIX IX SAMPLING PARAMETERS

Contaminant	Present Screening Action Level[a]		Practical Quantitation Limit[b]		SW 846 Analytical Method[c]	
	Water (mg/l)	Soil (mg/kg)	Water (mg/l)	Soil (mg/kg)	Water	Soil
Methyl ethyl ketone	1.7	2100	0.1	0.1	8240	8240
Methyl iodide	TBD[d]	TBD[d]	0.005	0.005	8240	8240
Methyl methacrylate	TBD[d]	TBD[d]	0.005	0.05	8240	8240
4-Methyl-2-pentanone	1.7	510	0.05	0.05	8240	8240
Pentachloroethane	TBD[d]	TBD[d]	0.01	0.01	8240	8240
2-Picoline	TBD[d]	TBD[d]	0.01	0.01	8240	8240
Propionitrile	TBD[d]	TBD[d]	0.01	0.01	8240	8240
Pyridine	TBD[d]	TBD[d]	0.005	0.005	8240	8240
Styrene	0.1	16000	1.0E-4	1.0E-4	8240	8240
1,1,1,2-Tetrachloroethane	TBD[d]	TBD[d]	0.005	0.005	8240	8240
1,1,2,2-Tetrachloroethane	0.0018	3.9	1.0E-4	1.0E-4	8240	8240
Tetrachloroethene	6.7E-4	5.9	4.0E-4	4.0E-4	8021	8021
Toluene	0.75	890	0.005	0.005	8240	8240
1,1,1-Trichloroethane	0.06	1000	0.005	0.005	8240	8240
1,1,2-Trichloroethane	0.0061	6.3	0.005	0.005	8240	8240
Trichloroethene	0.0032	3.2	2.0E-4	2.0E-4	8021	8021
Tricholorofluoromethane	TBD[d]	TBD[d]	3.0E-4	3.0E-4	8021	8021
1,2,3-Trichloropropane	TBD[d]	TBD[d]	0.005	0.005	8240	8240
Vinyl acetate	TBD[d]	TBD[d]	0.05	0.05	8240	8240
Vinyl chloride	1.8E-5[e]	0.013	4.0E-4	4.0E-4	8021	8021
Xylenes (total)	0.62	1.6E+5	0.005	0.005	8240	8240
Semi-Volatile Compounds						
Acenaphthene	2.1	4800	0.01	0.66	8270	8270
Acenaphthylene	TBD[d]	TBD[d]	0.01	0.66	8270	8270
Acetophenone	TBD[d]	TBD[d]	0.01	NA	8270	8270
2-Acetylaminofluorene	TBD[d]	TBD[d]	0.02	NA	8270	8270
4-Aminobiphenyl	TBD[d]	TBD[d]	0.02	NA	8270	8270
Aniline	TBD[d]	TBD[d]	NA	NA	8270	8270
Anthracene	10.0	24000	0.01	0.66	8270	8270
Aramite	TBD[d]	TBD[d]	0.01	0.66	8270	8270
Benzo[a]anthracene	TBD[d]	TBD[d]	1.3E-4	8.7E-3	8310	8310
Benzo[b]fluoranthene	TBD[d]	TBD[d]	1.8E-4	0.012	8310	8310
Benzo[k]fluoranthene	TBD[d]	TBD[d]	1.7E-4	0.011	8310	8310

Table 5.2 (continued)
APPENDIX IX SAMPLING PARAMETERS

Contaminant	Present Screening Action Level[a]		Practical Quantitation Limit[b]		SW 846 Analytical Method[c]	
	Water (mg/l)	Soil (mg/kg)	Water (mg/l)	Soil (mg/kg)	Water	Soil
Benzo[ghi]perylene	TBD[d]	TBD[d]	7.6E-4	0.051	8310	8310
Benzo[a]pyrene	4.8E-6[e]	0.1	2.3E-4	1.5E-2	8310	8310
Benzyl alcohol	TBD[d]	TBD[d]	0.20	1.30	8270	8270
Bis(2-chloroethoxy)methane	TBD[d]	TBD[d]	0.10	0.66	8270	8270
Bis(2-chloroethyl)ether	3.2E-5[e]	0.13[e]	0.01	0.66	8270	8270
Bis(2-chloro-1-methylethyl)ether	TBD[d]	TBD[d]	0.10	0.66	8270	8270
Bis(2-ethylhexyl)phthalate	0.0025[e]	50	0.0027	0.66	8061	8270
4-Bromophenylphenylether	TBD[d]	TBD[d]	0.10	0.66	8270	8270
Butylbenzylphthalate	7.0	16000	4.2E-4	0.66	8061	8270
p-Chloroaniline	0.14[e]	320	0.20	1.30	8270	8270
Chlorobenzilate	TBD[d]	TBD[d]	0.10	0.66	8270	8270
p-Chloro-m-cresol	70	1.6E+5	0.02	1.3	8270	8270
2-Chloronaphthalene	2.8	6400	0.01	0.66	8270	8270
2-Chlorophenol	0.17	400	0.01	0.66	8270	8270
4-Chlorophenyl phenylether	TBD[d]	TBD[d]	0.01	0.66	8270	8270
Chrysene	TBD[d]	TBD[d]	0.01	0.66	8270	8270
o-Cresol	1.7	4000	0.01	NA	8270	8270
m-Cresol	1.7	4000	0.01	NA	8270	8270
p-Cresol	1.7	4000	0.01	NA	8270	8270
Diallate	TBD[d]	TBD[d]	0.01	NA	8270	8270
Dibenzofuran	TBD[d]	TBD[d]	0.01	0.66	8270	8270
Di-n-butylphthalate	3.5	8000	0.0033	0.2	8061	8270
Dibenz[a,h]anthracene	TBD[d]	TBD[d]	3.0E-4	2.0E-2	8310	8310
o-Dichlorobenzene	0.6	1600	0.01	0.66	8270	8270
m-Dichlorobenzene	TBD[d]	TBD[d]	0.01	0.66	8270	8270
p-Dichlorobenzene	0.015	290	0.01	0.66	8270	8270
3,3-Dichlorobenzidine	7.8E-5[e]	1.6	0.02	1.30	8270	8270
2,4-Dichlorophenol	0.10	240	0.01	0.66	8270	8270
2,6-Dichlorophenol	TBD[d]	TBD[d]	0.01	0.66	8270	8270
Diethyl phthalate	28.0	6.4E+4	0.0025	0.66	8061	8270
O,O-diethyl-O-2-pyrzinyl Phosphorothioate	TBD[d]	TBD[d]	0.01	0.66	8270	8270

Table 5.2 (continued)
APPENDIX IX SAMPLING PARAMETERS

Contaminant	Present Screening Action Level[a]		Practical Quantitation Limit[b]		SW 846 Analytical Method[c]	
	Water (mg/l)	Soil (mg/kg)	Water (mg/l)	Soil (mg/kg)	Water	Soil
Dimethoate	TBD[d]	TBD[d]	0.02	1.3	8270	8270
p-(dimethylamino)azobenzene	TBD[d]	TBD[d]	0.01	0.66	8270	8270
7,12-Dimethylbenz[a]anthracene	TBD[d]	TBD[d]	0.01	0.66	8270	8270
3,3'-Dimethylbenzidine	TBD[d]	TBD[d]	0.01	0.66	8270	8270
a,a-Dimethylphenethylamine	TBD[d]	TBD[d]	0.01	0.66	8270	8270
2,4-Dimethylphenol	0.7	1600	0.01	0.66	8270	8270
Dimethylphthalate	35.0	8.0E+4	0.0064	0.66	8061	8270
m-Dinitrobenzene	TBD[d]	TBD[d]	0.02	1.3	8270	8270
4,6-Dinitro-o-cresol	TBD[d]	TBD[d]	0.05	3.3	8270	8270
2,4-Dinitrophenol	0.07	200	0.05	3.30	8270	8270
2,4-Dinitrotoluene	5.1E-5[e]	1.0	2.0E-4	0.66	8090	8270
2,6-Dinitrotoluene	5.1E-5[e]	1.0	0.01	0.66	8270	8270
Di-n-octyl phthalate	0.7	1600	4.9E-4	0.66	8061	8270
Diphenylamine	TBD[d]	TBD[d]	0.01	0.66	8270	8270
Ethyl methanesulfonate	TBD[d]	TBD[d]	0.02	1.3	8270	8270
Famphur	TBD[d]	TBD[d]	0.02	1.3	8270	8270
Fluoranthene	1.4	3200	0.01	0.66	8270	8270
Fluorene	1.4	3200	0.01	0.66	8270	8270
Hexachlorobenzene	2.2E-5[e]	0.44	5.6E-5	3.7E-5	8121	8121
Hexachlorocyclopentadiene	0.24	560	0.01	0.66	8270	8270
Hexachloroethane	0.025	500	0.01	0.66	8270	8270
Hexachlorophene	TBD[d]	TBD[d]	0.05	3.3	8270	8270
Indeno (1,2,3-cd)pyrene	TBD[d]	TBD[d]	0.01	0.66	8270	8270
Isodrin	TBD[d]	TBD[d]	0.02	1.3	8270	8270
Isophorone	0.37	7400	0.01	0.66	8270	8270
Isosafrole	TBD[d]	TBD[d]	0.01	0.66	8270	8270
Kepone	TBD[d]	TBD[d]	0.02	1.3	8270	8270
Methapyrilene	TBD[d]	TBD[d]	0.10	6.6	8270	8270
3-Methylcholanthrene	TBD[d]	TBD[d]	0.01	0.66	8270	8270
Methyl methanesulfonate	TBD[d]	TBD[d]	0.01	0.66	8270	8270
2-Methylnaphthalene	TBD[d]	TBD[d]	NA	0.66	8270	8270
Naphthalene	0.03	3200	0.01	0.66	8270	8270
1,4-Naphthoquinone	TBD[d]	TBD[d]	0.01	0.66	8270	8270
1-Naphthylamine	TBD[d]	TBD[d]	0.01	0.66	8270	8270
2-Naphthylamine	TBD[d]	TBD[d]	0.01	0.66	8270	8270

Table 5.2 (continued)
APPENDIX IX SAMPLING PARAMETERS

Contaminant	Present Screening Action Level[a]		Practical Quantitation Limit[b]		SW 846 Analytical Method[c]	
	Water (mg/l)	Soil (mg/kg)	Water (mg/l)	Soil (mg/kg)	Water	Soil
o-Nitroaniline	0.0021[e]	4.8	0.05	3.30	8270	8270
m-Nitroaniline	TBD[d]	TBD[d]	0.05	3.30	8270	8270
p-Nitroaniline	TBD[d]	TBD[d]	0.20	1.3	8270	8270
Nitrobenzene	0.018	5.3	0.01	0.66	8270	8270
o-Nitrophenol	TBD[d]	TBD[d]	0.01	0.66	8270	8270
p-Nitrophenol	TBD[d]	TBD[d]	0.05	3.30	8270	8270
4-Nitroquinoline-1-oxide	TBD[d]	TBD[d]	0.04	2.6	8270	8270
n-Nitrosodi-n-butylamine	TBD[d]	TBD[d]	0.01	0.66	8270	8270
n-Nitrosodiethylamine	TBD[d]	TBD[d]	0.02	1.3	8270	8270
n-Nitrosodimethylamine	TBD[d]	TBD[d]	0.01	0.66	8270	8270
n-Nitrosodiphenylamine	0.0071[e]	140	0.01	0.66	8270	8270
n-Nitrosodipropylamine	5.0E-6[e]	0.10[e]	0.01	0.66	8270	8270
n-Nitrosomethylethylamine	TBD[d]	TBD[d]	0.01	0.66	8270	8270
n-Nitrosomorpholine	TBD[d]	TBD[d]	0.01	0.66	8270	8270
n-Nitrosopiperidine	TBD[d]	TBD[d]	0.02	1.3	8270	8270
n-Nitrosopyrrolidine	TBD[d]	TBD[d]	0.04	2.6	8270	8270
5-Nitro-o-toluidine	TBD[d]	TBD[d]	0.01	0.66	8270	8270
Pentachlorobenzene	TBD[d]	TBD[d]	0.01	0.66	8270	8270
Pentachloronitrobenzene	TBD[d]	TBD[d]	0.02	1.3	8270	8270
Pentachlorophenol	2.9E-4[e]	5.8	0.05	3.30	8270	8270
Phenacetin	TBD[d]	TBD[d]	0.02	1.3	8270	8270
Phenanthrene	TBD[d]	TBD[d]	0.01	0.66	8270	8270
Phenol	21.0	48000	0.01	0.66	8270	8270
p-Phenylenediamine	TBD[d]	TBD[d]	0.01	0.66	8270	8270
Pronamide	TBD[d]	TBD[d]	0.01	0.66	8270	8270
Pyrene	1.0	2400	0.01	0.66	8270	8270
Safrole	TBD[d]	TBD[d]	0.01	0.66	8270	8270
1,2,4,5-Tetrachlorobenzene	TBD[d]	TBD[d]	0.01	0.66	8270	8270
2,3,4,6-Tetrachlorophenol	TBD[d]	TBD[d]	0.01	0.66	8270	8270
Tetraethyldithiopyrophosphate	TBD[d]	TBD[d]	0.01	0.66	8270	8270
o-Toluidine	TBD[d]	TBD[d]	0.01	0.66	8270	8270
1,2,4-Trichlorobenzene	0.35	160	0.01	0.66	8270	8270
2,4,5-Trichlorophenol	3.5	8000	0.01	0.66	8270	8270
2,4,6- Trichlorophenol	0.0032[e]	64	0.01	0.66	8270	8270
O,O,O,-Triethylphosphorothioate	TBD[d]	TBD[d]	0.01	0.66	8270	8270

Table 5.2 (continued)
APPENDIX IX SAMPLING PARAMETERS

Contaminant	Present Screening Action Level[a]		Practical Quantitation Limit[b]		SW 846 Analytical Method[c]	
	Water (mg/l)	Soil (mg/kg)	Water (mg/l)	Soil (mg/kg)	Water	Soil
sym-Trinitrobenzene	TBD[d]	TBD[d]	0.01	0.66	8270	8270
Organochlorine Pesticides and PCBs						
Aldrin	TBD[d]	TBD[d]	4.0E-5	2.68E-3	8080	8080
alpha-BHC	TBD[d]	TBD[d]	3.0E-5	2.01E-3	8080	8080
beta-BHC	TBD[d]	TBD[d]	6.0E-5	4.02E-3	8080	8080
delta-BHC	TBD[d]	TBD[d]	9.0E-5	6.03E-3	8080	8080
Lindane	TBD[d]	TBD[d]	4.0E-5	2.68E-3	8080	8080
Chlordane	TBD[d]	TBD[d]	1.4E-4	9.38E-3	8080	8080
4,4-DDD	TBD[d]	TBD[d]	1.1E-4	7.37E-3	8080	8080
4,4-DDE	TBD[d]	TBD[d]	4.0E-5	2.68E-3	8080	8080
4,4-DDT	TBD[d]	TBD[d]	1.2E-4	8.04E-3	8080	8080
Dieldrin	TBD[d]	TBD[d]	2.0E-5	1.34E-3	8080	8080
Endosulfan I	TBD[d]	TBD[d]	1.4E-4	9.38E-3	8080	8080
Endosulfan II	TBD[d]	TBD[d]	4.0E-5	2.68E-3	8080	8080
Endosulfan sulfate	TBD[d]	TBD[d]	6.6E-4	4.42E-2	8080	8080
Endrin	TBD[d]	TBD[d]	6.0E-5	4.02E-3	8080	8080
Endrin aldehyde	TBD[d]	TBD[d]	2.3E-4	1.54E-2	8080	8080
Heptachlor	TBD[d]	TBD[d]	3.0E-5	2.01E-3	8080	8080
Heptachlor epoxide	TBD[d]	TBD[d]	8.3E-4	5.56E-2	8080	8080
Methoxychlor	TBD[d]	TBD[d]	1.7E-3	0.118	8080	8080
Toxaphene	TBD[d]	TBD[d]	2.4E-3	0.161	8080	8080
Aroclor 1016	TBD[d]	TBD[d]	5.0E-4	2.0E-2	8080	8080
Aroclor 1221	TBD[d]	TBD[d]	5.0E-4	2.0E-2	8080	8080
Aroclor 1232	TBD[d]	TBD[d]	5.0E-4	2.0E-2	8080	8080
Aroclor 1242	TBD[d]	TBD[d]	6.5E-3	4.36E-2	8080	8080
Aroclor 1248	TBD[d]	TBD[d]	5.0E-4	2.0E-2	8080	8080
Aroclor 1254	TBD[d]	TBD[d]	0.001	3.0E-2	8080	8080
Aroclor 1260	TBD[d]	TBD[d]	0.001	3.0E-2	8080	8080
Inorganic Compounds[f]						
Antimony	0.014	32.0	0.003	0.6	7041	7041
Arsenic	2.0E-5[e]	0.4	0.005	1.0	7060	7060

Table 5.2 (continued)
APPENDIX IX SAMPLING PARAMETERS

Contaminant	Present Screening Action Level[a]		Practical Quantitation Limit[b]		SW 846 Analytical Method[c]	
	Water (mg/l)	Soil (mg/kg)	Water (mg/l)	Soil (mg/kg)	Water	Soil
Barium	1.0	5600	0.002	0.4	6010	6010
Beryllium	8.1E-6[e]	0.16[e]	3.0E-4	0.06	6010	6010
Cadmium	0.005	80	0.004	0.8	6010	6010
Chromium	0.05	400	0.007	1.4	6010	6010
Cobalt	TBD[d]	TBD[d]	0.007	1.4	6010	6010
Copper	1.3	3000	0.006	1.2	6010	6010
Lead	0.05	TBD[d]	0.001	1.2	7421	7421
Mercury	0.002	24	2.0E-4	0.2	7470	7471
Nickel	0.70	1600	0.015	3.0	6010	6010
Selenium	0.05	400	0.002	0.4	7740	7740
Silver	0.05	400	0.007	1.4	6010	6010
Thallium	0.0028	6.4	0.001	0.2	7841	7841
Tin	TBD[d]	TBD[d]	0.8	160	7870	7870
Vanadium	0.24	560	0.008	1.6	6010	6010
Zinc	10.0	24000	0.002	0.4	6010	6010
Cyanide	0.20	1600	0.02	4.0	9012	9012

NA = Not applicable or not available.

a Source: LANL 1992, 0768, Appendix J. Screening action level criteria in effect at the time of sampling will be used in analyzing the data from Phase I activities.

b Practical quantitation limits in effect will depend on the laboratory capabilities and program needs, the screening action level criteria in effect at the time of the sampling will be used to set these limits.

c Methods are from EPA SW-846 (EPA 1987, 0518) unless otherwise indicated. Alternative analytical methods may be used if the alternative method meets all of the requirements specified in this QAPjP. In addition, alternative methods will be sought if the PQL is greater than the screening action level in effect at the time of sampling.

d To be determined. Screeening action level criteria were not available at the time of Work Plan preparation.

e Current EPA methodology is unable to detect these compounds at the required screening action level. Special analytical methods will be developed to achieve the required screening action levels. The methods suggested for these compounds are the most appropriate standard methods in use on this project.

f The practical quantitation limits given for the inorganic compounds are the method detection limits for water samples. The method detection limits for soil samples depend on the sample matrix and digestion technique. The soil sample detection limits are estimated on the basis of the sample preparation methods listed in the cited methods.

action levels. Several alternate methods are listed in Table 5.3 that may be required to meet the screening action levels. The precision and accuracy for these methods are discussed in the following sections.

5.3 Quality Assurance Objectives for Precision

The QA objectives for precision for the OU 1098 RFI will be taken from SW-846 (EPA 1987, 0518) as described in Sections 5.3, 5.3.1, and 5.3.2 and Table V.11 of the Generic QAPjP. All of the precision requirements described in the Generic QAPjP will apply to the OU 1098 RFI with the following additions:

- for the additional metal analytical methods specified in Table 5.3, the relative percent difference (RPD) limits specified for metals in Section 5.3.1 of the Generic QAPjP will be applied; and
- for the additional organic analytical methods specified in Table 5.3, the QA objectives for precision are provided in Table 5.4.

5.4 Quality Assurance Objectives for Accuracy

The QA objectives for accuracy for the OU 1098 RFI, excluding radiological contaminants, will be from SW-846 (EPA 1987, 0518) as described in Sections 5.4, 5.4.1, and 5.4.2 and Tables V.11 and V.12 of the Generic QAPjP. All of the accuracy requirements described in the Generic QAPjP will apply to the OU 1098 RFI with the following additions:

- for the additional metal analytical methods specified in Table 5.3, the percent recovery limits specified for metals in Section 5.4.1 of the Generic QAPjP will be applied; and
- for the additional organic analytical methods specified in Table 5.3, the QA objectives for accuracy are provided in Table 5.4.

5.5 Representativeness, Completeness, and Comparability

The representativeness of the analytical data will be attained through the technical approach described in Section 2.0 of the RFI Work Plan and the specific sampling plans described in Section 7.0 of the RFI Work Plan. Additional information to be used to attain representativeness is included in the discussions of site-specific data needs and DQOs in Section 6.0 of the RFI Work Plan and in the list of site-specific SOPs given in Table 7.3-1 of the RFI Work Plan.

The completeness goal of 90% set for the ER Program will apply overall to the OU 1098 RFI as described in Section 5.5 of the Generic QAPjP. Additional actions will be required when the completeness goals are not achieved for critical samples.

Table 5.3
Additional Analytical Methods for Operable Unit 1098

Method Number[a]	Description
Organic Methods	
SW-846 Method 8021	Volatile halogenated and aromatic compounds
SW-846 Method 8061	Phthalate esters
SW-846 Method 8141	Organophosphate pesticides
SW-846 Method 8310	Polynuclear aromatic compounds
To be determined	Bromoform
To be determined	1,1-Dichloroethene
To be determined	cis-1,3-Dichloropropene
To be determined	trans-1,3-Dichloropropene
To be determined	Vinyl chloride
To be determined	Benzo(a)pyrene
To be determined	bis(2-Chloroethyl)ether
To be determined	bis(2-Ethylhexyl)phthalate
To be determined	p-Chloroaniline
To be determined	3,3-Dchlorobenzidene
To be determined	2,4-Dinitrotoluene
To be determined	2,6-Dinitrotoluene
To be determined	Hexachlorobenzene
To be determined	o-Nitroaniline
To be determined	n-Nitrosodiphenylamine
To be determined	n-Nitrosodipropylamine
To be determined	pentachlorophenol
To be determined	2,4,6-Trichlorophenol
Inorganic Methods	
SW-846 Method 7470	Mercury
SW-846 Method 7041	Antimony
SW-846 Method 7421	Lead
SW-846 Method 7740	Selenium
SW-846 Method 7841	Thallium
SW-846 Method 7870	Tin
To be determined	Arsenic
To be determined	Beryllium

[a] The method numbers given are from SW-846 Test Methods for Evaluating Solid Waste (EPA 1986). Some methods are listed as "to be determined" because standard EPA methodology is unable to attain the screening action level indicated in Table 5.2. These methods will be developed as part of the OU 1098 Laboratory QA Program prior to the initiation of field sampling.

Table 5.4
Accuracy and Precision Limits for the Additional Methods for OU 1098

Analyte of Interest	Soil Method	Water Method	Soil Accuracy	Soil Precision	Water Accuracy	Water Precision
Benzene	8021	8021	25 RPD	25%	25 RPD	25%
Bromodichloromethane	8021	8021	25 RPD	25%	25 RPD	25%
Carbon tetrachloride	8021	8021	25 RPD	25%	25 RPD	25%
Chloroform	8021	8021	25 RPD	25%	25 RPD	25%
Dibromochloromethane	8021	8021	25 RPD	25%	25 RPD	25%
1,2-Dibromo-3-chloro-propane	8021	8021	25 RPD	25%	25 RPD	25%
Dichlorodifluoromethane	8021	8021	25 RPD	25%	25 RPD	25%
1,2-Dichloroethane	8021	8021	25 RPD	25%	25 RPD	25%
1,2-Dichloropropane	8021	8021	25 RPD	25%	25 RPD	25%
Hexachlorbutadiene	8021	8021	25 RPD	25%	25 RPD	25%
Methylene chloride	8021	8021	25 RPD	25%	25 RPD	25%
Tetrachloroethene	8021	8021	25 RPD	25%	25 RPD	25%
Trichloroethene	8021	8021	25 RPD	25%	25 RPD	25%
Tricholorofluoromethane	8021	8021	25 RPD	25%	25 RPD	25%
Phthalates						
Butylbenzylphthalate	8061	8270	25 RPD	25%	25 RPD	25%
Di-n-butyl phthalate	8061	8270	25 RPD	25%	25 RPD	25%
Diethyl phthalate	8061	8270	25 RPD	25%	25 RPD	25%
Dimethyl phthalate	8061	8270	25 RPD	25%	25 RPD	25%
Di-n-octyl phthalate	8061	8270	25 RPD	25%	25 RPD	25%
Polynuclear Aromatics						
Benzo[a]anthracene	8310	8310	25 RPD	25%	25 RPD	25%
Benzo[b]fluoranthene	8310	8310	25 RPD	25%	25 RPD	25%
Benzo[k]fluoranthene	8310	8310	25 RPD	25%	25 RPD	25%
Benzo[ghi]perylene	8310	8310	25 RPD	25%	25 RPD	25%
Dibenz[a,h]anthracene	8310	8310	25 RPD	25%	25 RPD	25%
Other Analytes[a]						
Bromoform	TBD	TBD	25 RPD	25%	25 RPD	25%
1,1-Dichloroethene	TBD	TBD	25 RPD	25%	25 RPD	25%
cis-1,3-Dichloropropene	TBD	TBD	25 RPD	25%	25 RPD	25%
trans-1,3-Dichloro-propene	TBD	TBD	25 RPD	25%	25 RPD	25%
Vinyl chloride	TBD	TBD	25 RPD	25%	25 RPD	25%
Bis(2-ethylhexyl)phthalate	TBD	TBD	25 RPD	25%	25 RPD	25%
Bis(2-chloroethyl)ether	TBD	TBD	25 RPD	25%	25 RPD	25%
p-Chloroaniline	TBD	TBD	25 RPD	25%	25 RPD	25%
3,3-Dichlorobenzidine	TBD	TBD	25 RPD	25%	25 RPD	25%
Hexachlorobenzene	TBD	TBD	25 RPD	25%	25 RPD	25%
2,4-Dinitrotoluene	TBD	TBD	25 RPD	25%	25 RPD	25%
2,6-Dinitrotoluene	TBD	TBD	25 RPD	25%	25 RPD	25%
o-Nitroaniline	TBD	TBD	25 RPD	25%	25 RPD	25%
n-Nitrosodiphenylamine	TBD	TBD	25 RPD	25%	25 RPD	25%
n-Nitrosodipropylamine	TBD	TBD	25 RPD	25%	25 RPD	25%
Pentachlorophenol	TBD	TBD	25 RPD	25%	25 RPD	25%
2,4,6- Trichlorophenol	TBD	TBD	25 RPD	25%	25 RPD	25%
Benzo[a]pyrene	TBD	TBD	25 RPD	25%	25 RPD	25%

Comparability will be achieved through the use of the standard methods listed in Tables 5.1 and 5.2 as well as through the use of the LANL-ER-SOPs listed in •. The comparability requirements specified in Section 5 the Generic QAPjP will apply to the OU 1098 RFI.

5.6 Field Measurements

The primary QA objectives for field measurements described in Section 5.6 of the Generic QAPjP apply to the OU 1098 RFI. These QA objectives will be achieved through the use of appropriate methodologies described in the LANL-ER-SOPs for each site activity. These SOPs are listed in Table 4.4-1 of the RFI Work Plan.

5.7 Data Quality Objectives

The qualitative and quantitative statements that specify the quality of the data required to support the OU 1098 RFI decision process are described in this OU work plan. The analyte-specific sensitivity, precision, and accuracy requirements presented in Tables 5.1, 5.2, and 5.4 of this QAPjP describe the QA objectives for measurement data that could be considered to provide for the collection of analytical data with acceptable levels of uncertainty. The decision process and acceptable levels of uncertainty are presented in Section 6.4 of the RFI Work Plan. Site-specific decisions and investigation objectives are described in Section 6 of the RFI Work Plan. The sampling and analysis strategies and approaches as well as the required sampling and analyses for each site are described in Section 7 of the RFI Work Plan.

5.8 Quality Improvement

The OU 1098 Phase I Project will be conducted following the quality improvement guidelines described in Section 20 of the QPP. The quality improvement activities to be conducted as part of the project include the following:

- A project kickoff meeting where all project participants will meet to discuss the responsibilities of each participant, the project schedules and how they impact the overall project, nonconformance reporting, health and safety requirements, and to get feedback on the project plans.
- Readiness reviews prior to commencing each major field activity to cover the same topics discussed at the project kickoff meeting and how these topics relate to the field activity to be conducted.
- Daily tailgate meetings to review the daily sampling objectives and health and safety aspects of the work to be conducted by the field crew that day.

- A close-out meeting at the end of each major sampling activity to review the performance and to suggest improvements for subsequent activities.

6.0 Sampling Procedures

The activities to be conducted during the OU 1098 RFI will follow the procedures described in this section and in Section 6 of the Generic QAPjP. The SOPs to be used during the OU 1098 RFI are listed in Table 5.5. These procedures cover the sample collection, handling, and shipping procedures, as well as the QA procedures that will be followed during the project. These procedures were selected from the ER Program procedures listed in Appendix L of the IWP.

6.1 Quality Control Samples

QC samples will be collected as described in Section 6.1 of the Generic QAPjP with the exceptions given in Section 5.1 of this QAPjP.

6.2 Sample Preservation During Shipment

All samples will be handled following the guidance in Section 6 of the Generic QAPjP and the appropriate LANL-ER-SOPs listed in Table 5.5. The following specific SOPs will be used for sample preservation during shipment. Samples will be controlled and documented in the field following LANL-ER-SOP-01.04, Sample Control and Field Documentation. Samples will be contained and preserved following LANL-ER-SOP-01.02, Samples Containers and Preservation. The essential sample container and preservation information from LANL-ER-SOP-01.02 pertaining to the OU 1098 RFI is summarized in Table 6.1. The handling, packaging, and shipping of samples will follow LANL-ER-SOP-01.03, Handling, Packaging, and Shipping of Samples.

6.3 Equipment Decontamination

Equipment will be decontaminated following the procedure described in Section 6.3 of the Generic QAPjP and LANL-ER-SOP-02.07, General Equipment Decontamination. In addition, any equipment-specific decontamination procedures specified in the sampling equipment SOPs will also be followed.

6.4 Sample Designation

As described in Section 6.4 of the Generic QAPjP, LANL-ER-SOP-01.04, Sample Control and Field Documentation, will be followed for designating sample numbers. The sample numbers will be designated with the assistance of ER Program personnel familiar with LANL-ER-SOP-01.04.

Table 5.5
Standard Operating Procedures for Operable Unit 1098

Standard Operating Procedure	
Number	**Description**
General Instructions	
LANL-ER-SOP-01.01	General Instructions for Field Investigations
LANL-ER-SOP-01.02	Sample Containers and Preservation
LANL-ER-SOP-01.03	Handling, Packaging, and Shipping of Samples
LANL-ER-SOP-01.04	Sample Control and Field Documentation
LANL-ER-SOP-01.05	Field Quality Control Samples
LANL-ER-SOP-01.06	Management of RFI-Generated Wastes
TBDb	Data Validation Procedures
Health and Safety in the Field	
LANL-ER-SOP-02.01a	Personal Protective Equipment
LANL-ER-SOP-02.02a	Respirators
LANL-ER-SOP-02.03a	Pre-Entry Briefings for Site Personnel
LANL-ER-SOP-02.04a	Pre-Entry Briefings for Visitors
LANL-ER-SOP-02.05a	Safety Meetings and Inspections
LANL-ER-SOP-02.06a	Heat and Cold Stress and Natural Hazards
LANL-ER-SOP-02.07a	General Equipment Decontamination
LANL-ER-SOP-02.08a	Personnel Decontamination
LANL-ER-SOP-02.09a	Accident/Incident Reporting
LANL-ER-SOP-02.10a	Radiation Protection
LANL-ER-SOP-02.11a	Training and Medical Surveillance
Field Surveys	
TBDb	Hand-held Instruments for Field Screening of VOCs
TBDb	Hand-held Instruments for Field Screening of Radioactive Substances
ER-SOP-03.02	General Surface Geophysics
LANL-ER-SOP-04.01	Drilling Methods and Drill Site Management
LANL-ER-SOP-04.04a	General Borehole Logging
TBDb	Spill Control During Drilling
	Sampling Techniques
LANL-ER-SOP-06.02	Field Analytical Measurements of Ground Water
LANL-ER-SOP-06.03	Sampling for Volatile Organics
LANL-ER-SOP-06.05	Soil Water Samples
LANL-ER-SOP-06.09	Spade and Scoop Method for Collection of Soil Samples
LANL-ER-SOP-06.10	Hand Auger and Thin-Wall Tube Sampler
LANL-ER-SOP-06.11	Stainless Steel Surface Soil Sampler
LANL-ER-SOP-06.12	Soil and Rock Borehole Logging and Sampling
LANL-ER-SOP-06.13	Surface Water Sampling
LANL-ER-SOP-06.14	Sediment Material Collection
LANL-ER-SOP-06.17	Trier Samples for Sludges and Moist Powders or Granules

TABLE 5.5 (continued)

LANL-ER-SOP-06.19	Weighted Bottle Sampler for Liquids and Slurries in Tanks
TBDb	Field Surveying of Sample Locations
Curatorial Sample Management	
LANL-ER-SOP-12.01	Field Logging, Handling, and Documenting Borehole Samples
LANL-ER-SOP-12.02	Transport and Receipt of Borehole Samples by the Curatorial Management Facility
Curatorial Sample Management (continued)	
LANL-ER-SOP-12.03	Physical Processing and Storage of Borehole Samples at the Curatorial Management Facility
LANL-ER-SOP-12.04	Examination of Samples at the Curatorial Management Facility
LANL-ER-SOP-12.05	Acceptance of Non-Borehole Samples by the Curatorial Management Facility
Quality Procedures	
LANL-ER-QP-01.1Q	Audits
LANL-ER-QP-01.2Q	Surveys
LANL-ER-QP-01.3Q	Deficiency Reporting
Administrative Procedures	
LANL-ER-AP-01.3	Review and Approval of Environmental Restoration Program Plans and Reports
LANL-ER-AP-01.5	Revision or Interim Change of Environmental Program Controlled Documents
ICN-NO-002	Interim Change Notice for LANL-ER-AP-01.5, R0
LANL-ER-AP-02.1a	Procedure for LANL ER Records Management
LANL-ER-AP-03.2	Handling Media and Public Requests for Information During Field Work
LANL-ER-AP-04.1	Identification, Documentation, and Reporting of Newly Discovered Potential Release Sites for the Environmental Restoration Program
LANL-ER-AP-03.2	Handling Media and Public Requests for Information During Field Work
LANL-ER-AP-04.1	Identification, Documentation, and Reporting of Newly Discovered Potential Release Sites for the Environmental Restoration Program
LANL-ER-AP-04.2	Reporting of Newly Identified Releases from Solid Waste Management Unit

[a] This procedure is in draft form

[b] This procedure is in preparation

Table 6.1
SAMPLE CONTAINER TYPES, VOLUMES, PREPARATION, SPECIAL HANDLING, PRESERVATION, HOLDING TIMES, AND MINIMUM SAMPLE QUANTITIES

Analysis	Containers	Handling and Preservation	Holding Time
Soil Samples			
Gross alpha, gross beta, and gamma spectroscopy	1, 250 ml plastic	Store 4 degrees C	6 months
Isotopic plutonium, tritium, and strontium-90	1, 250 ml plastic	Store 4 degrees C	6 months
Volatiles by Method 8240	3, 60 ml amber glass with Teflon-lined cap	Store 4 degrees C, handle upwind from equipment fumes, no contact with plastic or gloves	14 days
Metals, cyanide, total uranium, and technetium-99	1, 250 ml plastic	Store 4 degrees C	6 months all metals except mercury, whichis 28 days and cyanide 14 days
Appendix IX volatiles including methods 8240 and 8021	3, 60 ml amber glass with Teflon-lined caps	Store 4 degrees C, handle upwind from equipment fumes, no contact with plastic or gloves	14 days
Appendix IX semivolatiles, and organochlorine pesticides and PCBs including methods 8270, 8310, 8061, and 8080	2, 120 ml amber glass with Teflon-lined cap	Store 4 degrees C, handle upwind from equipment fumes, no contact with plastic or gloves	7 days until extraction, 30 days thereafter
Appendix IX metals and cyanide	1, 250 ml plastic	Store 4 degrees C	6 months all metals except mercury, which is 28 days and cyanide which is 14 days
Total Petroleum Hydrocarbons	1, 250 ml plastic	Store 4 degrees C	7 days until extraction, 30 days thereafter

Table 6.1 (continued)

Analysis	Containers	Handling and Preservation	Holding Time
Water Samples			
Gross alpha, gross beta, and gamma spectroscopy	1, 1 liter plastic	Store 4 degrees C	6 months
Isotopic plutonium, tritium, an strontium-90	1, 1 liter plastic	Store 4 degrees C	6 months,
Metals and total uranium	1, 500 ml plastic	Preserve with HNO_3 to pH < 2 and store at 4 degrees C	6 months uranium and all metals except mercury, which is 28 days
Appendix IX volatiles including methods 8240 and 8021	3, 40 m l amber glass with Teflon-lined caps per method	Store 4 degrees C, handle upwind from equipment fumes, no contact with plastic or gloves	14 days
Appendix IX semivolatiles, and organochlorine pesticides and PCBs, including methods 8270, 8310, 8061, and 8080	2, 1 liter amber glass with Teflon-lined cap per method	Store 4 degrees C, handle upwind from equipment fumes, no contact with plastic o gloves	7 days until extraction, 30 days r thereafter
Appendix IX metals	1, 500 ml plastic	Preserve with HNO_3 to pH < 2 and store at 4 degrees C	6 months all metals except mercury, which is 28 days
Appendix IX cyanide	1, 250 ml plastic	Preserve with NaOH to pH > 12 andC store at 4 degrees	14 days

7.0 Sample Custody

7.1 Overview

The strict chain-of-custody procedures contained in LANL-ER-SOP-01.04, Sample Control and Field Documentation, and described in Section 7.1 of the Generic QAPjP will be followed during the OU 1098 RFI. These procedures will be followed to help ensure the proper handling of samples from collection to analysis, including the final disposition of the analytical samples.

7.2 Field Documentation

7.2.1 Sample Identification

The samples will be identified following LANL-ER-SOP-01.04, Sample Control and Field Documentation, as described in Section 7.2.1 of the Generic QAPjP.

7.2.2 Field Logs

Field logs will be kept following the appropriate LANL-ER-SOPs and procedures described in Section 7.2.2 of the Generic QAPjP.

7.2.3 Data Collection Forms

Data collection forms will be used following the appropriate LANL-ER-SOPs as described in Section 7.2.3 of the Generic QAPjP.

7.2.4 Corrections to Documentation

Incorrect entries will be crossed out with a single line and signed and dated by the person originating the entry, and the appropriate LANL ER Program technical field team leader as described in Section 7.2.4 of the Generic QAPjP. The correct information will be entered and the correction signed and dated by the person making the correction. There will be no erasures or deletions from any type of data document record.

7.3 Sample Coordination Facility

All samples will initially be transported by the FTM or designated field team member to the LANL SCF. As described in Section 7.3 of the Generic QAPjP, the LANL SCF will coordinate the OU 1098 sample collection activities with the required chemical analysis. The procedures for sample handling will follow those described in Section 6 of this QAPjP.

7.4 Laboratory Documentation

The laboratory documentation procedures described in Section 7.4 and the related subsections in the Generic QAPjP will be followed for all samples collected and analyzed during the OU 1098 RFI.

7.5 Sample Handling, Packaging, and Shipping

The procedures described in Section 7.5 of the Generic QAPjP will be followed for all samples collected and analyzed during the OU 1098 RFI. As described in Section 7.3 above, all samples will initially be transported to the LANL SCF, which will handle all sample handling, packaging, and shipping following the appropriate LANL procedures described in Section 6 of this QAPjP.

7.6 Final Evidence File Documentation

All OU 1098 RFI project participants will maintain records to document the QA/QC activities and to provide support for possible evidential proceedings. All records generated during the OU 1098 RFI are the property of the LANL ER Program Office. The OU 1098 Records Management Plan (Annex IV to the RFI Work Plan) and the LANL Records Management Program (LANL 1992, 0814) describe the procedures that will be followed to provide final evidence documentation.

8.0 Calibration Procedures and Frequencies

The calibration procedures and their frequencies for the OU 1098 RFI are described in Section 8 of the Generic QAPjP.

9.0 Analytical Procedures

The analytical procedures for the OU 1098 RFI are listed in Tables 5.1 and 5.2. These procedures will be used for field testing and screening and laboratory analysis as described in Section 9 of the Generic QAPjP with the exception of those methods listed in Table 5.3.

For the methods specified in Table 5.3, the selected analytical laboratories will provide analytical method SOPs for the analyses to be conducted. The methods that require development will be documented to demonstrate that the appropriate level of data quality can be achieved before the methods are approved for use in the OU 1098 RFI. All analyses will be performed by an analytical laboratory with demonstrated proficiency for each parameter required.

10.0 Data Reduction, Validation, and Reporting

Data reduction, validation, and reporting will be conducted by LANL ER Program personnel and subcontractors as described in Section 10 of the

Generic QAPjP. In addition, the laboratory analytical data will be validated by individuals independent from the analytical laboratory that produced the data. The validation process is intended to determine whether the data received is of acceptable quality based on the DQOs specified in this QAPjP and the OU 1098 RFI Work Plan. The data validation procedures are escribed in the Data Validation SOP (to be developed) and follow EPA's "Functional Guidelines for Data Validation" (EPA 1988, 0293).

11.0 Internal Quality Control Checks

Internal QC checks will be conducted as described in Section 11 of the Generic QAPjP, with the exception of the field reagent blanks described in Section 5.1 of this QAPjP.

12.0 Performance and System Audits

Performance and system audits will be conducted during the OU 1098 RFI as identified in Section 12 of the Generic QAPjP. Audits will be conducted at least once per year or once per task, whichever is more frequent. In addition, all procedures used during the OU 1098 RFI will be audited at least once.

13.0 Preventive Maintenance

The preventive maintenance procedures for both field and laboratory equipment specified in Section 13 of the Generic QAPjP will be followed during the OU 1098 RFI.

14.0 Specific Routine Procedures used to Assess Data Precision, Accuracy, Representativeness, and Completeness

In order to provide data that is comparable to the data produced for other OU RFIs, the OU 1098 RFI will use the procedures described in Section 14 of the Generic QAPjP to assess data precision, accuracy, representativeness, and completeness.

15.0 Corrective Action

The procedures, reporting requirements, and authority for initiating corrective action during the OU 1098 RFI will follow those defined in Section 15 of the Generic QAPjP and in the LANL-ER-SOP-01.3Q, Deficiency Reporting.

16.0 Quality Assurance Reports to Management

QA reports to management will be prepared following the guidelines provided in Section 16 of the Generic QAPjP.

Annex II References

DOE (U.S. Department of Energy) 1983. EM Procedures Manual, HASL-300, Environmental Measures Laboratory, 26th edition, Washington, D.C. (DOE 1983, 0516)

EPA 1988. "Functional Guidelines for Data Validation", Organic and Inorganic Methods, Cincinnati, OH. (EPA 1988, 0293)

EPA (U.S. Environmental Protection Agency) 1987. Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846, Office of Solid Waste and Emergency Response, Washington, D.C. (EPA 1987, 0518)

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LANL, May 1991. "Generic Quality Assurance Project Plan," Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 1991, 0553)

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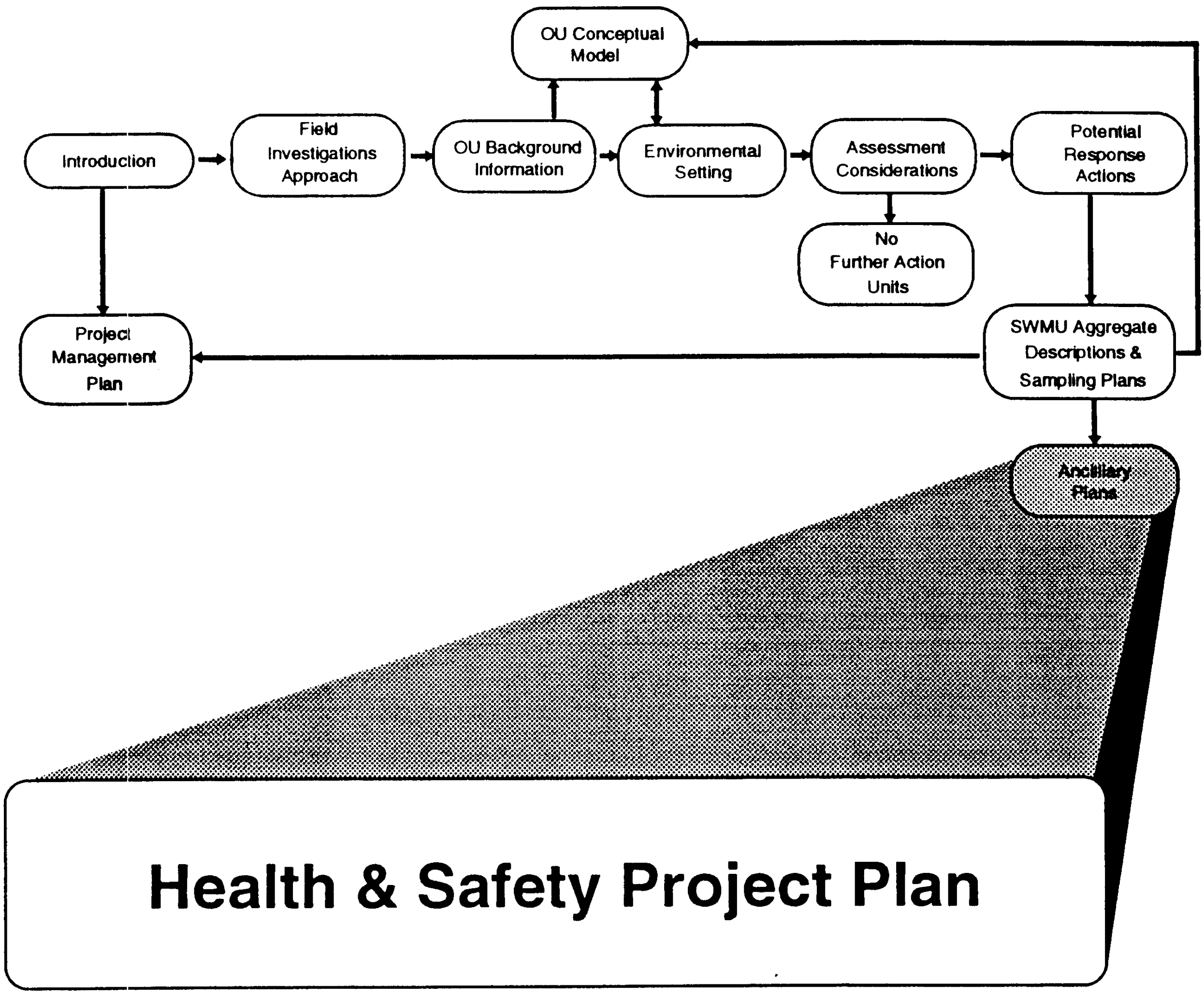
Annex III


OU Conceptual Model
Introduction
Field Investigations Approach
OU Background Information
Environmental Setting
Assessment Considerations
Potential Response Actions
No Further Action Units
Project Management Plan
SWMU Aggregate Descriptions & Sampling Plans
Ancillary Plans
Health & Safety Project Plan

List of Tables

List of Figures

ANNEX III PROJECT HEALTH AND SAFETY PLAN

1.0 Introduction

This Annex contains the OU-specific Project Health and Safety (H&S) Plan which has been developed for the RCRA Facility Investigation (RFI) at the TA-2 and TA-41 Operable Unit (OU), which also is referred to as OU 1098. This plan provides the framework within which personnel protection will be provided during the implementation of the RFI at TA-2 and TA-41. Task-specific health and safety plans will be prepared prior to the initiation of any field task. Task-specific plans also will describe the specific measures to be taken for personnel protection during implementation of the task and will define individual responsibilities which are outlined in the TA-2 and TA-41 OU Project Health and Safety Plan. Overall health and safety policy for the program is provided in Annex III (Health and Safety Plan) of the Installation Work Plan (IWP) (LANL 1991, 0553).

As field investigation progresses, measures for personnel protection may be identified which are more effective than those identified in this annex. Deviations from the TA-2 and TA-41 OU Project Health and Safety Plan will be documented in the pertinent task-specific plan along with the reasons for that deviation. As changes are required, the TA-2 and TA-41 OU Health and Safety Project Plan will be updated. A list of LANL ER standard operating procedures referenced in this OU work plan is provided as Attachment III-1 to this OU work plan.

The TA-2 and TA-41 OU Project Health and Safety Plan includes an assessment of potential hazards, justification for personnel protection requirements, and site specific emergency response procedures. A copy of this plan will be kept on site at all times.

The specific purpose of this annex is to establish guidelines for field personnel involved in OU-wide and SWMU-specific investigations at the TA-2 and TA-41 OU. This plan applies only to the field investigations associated with the TA-2 and TA-41 OU. A new plan must be initiated for any corrective actions. In addition to following the general guidance in the IWP, the following regulations and standards were used to develop the procedures set forth in this plan: Laboratory policies and H&S Manual, DOE Orders, Occupational Safety and Health Administration (OSHA) regulations, National Institute for Occupational Health (NIOSH) standards, American Conference of Governmental Industrial Hygienists (ACGIH) recommendations, Nuclear Regulatory Commission (NRC) regulations, and Environmental Protection Agency (EPA) guidance. Applicable state and local regulations also will be followed. These standards and regulations have been established for the protection of workers on hazardous and radioactive waste sites of the type which exist at the TA-2 and TA-41 OU. Therefore, adherence to this plan is essential to the health and safety of site workers as well as the general public.

The responsibilities of personnel with regard to the TA-2 and TA-41 OU health and safety as detailed herein do not distinguish whether Laboratory or contractor personnel are implementing this plan. If it is necessary to modify this plan for implementation, EPA will be notified of any such modifications.

Detailed background information, including descriptions of specific site hazards, for the TA-2 and TA-41 OU is contained in the OU work plan. Detailed maps of TA-2 and TA-41 showing the locations of SWMUs, access roads, topography, and other health and safety related features are contained in Figures EXEC-2 and EXEC-3 and in Appendix A.

2.0 OU Field Work Organization

The following information describes policies and standards set forth in this plan, including specific lines of responsibility, standards and regulations, and requirements for audits and variances of health and safety policies.

2.1 General Responsibilities

General RFI responsibilities are outlined in Section 5.0 of Annex III (H&S Plan) of the IWP. Listed below are specific responsibilities for personnel involved in the RFI for the TA-2 and TA-41 OU.

2.2 Individual Responsibilities

Within line management of the ER Program activities, there are certain employees and contractors with specific health and safety responsibilities. Figure III-1 shows a field work organization chart showing line organization responsibilities. Other organizational charts pertinent to the TA-2 and TA-41 RFI are presented in Annex I (Project Management Plan) of this OU work plan.

Los Alamos EM and HS Deputy Division Leaders

The Deputy Division Leaders of EM and HS Divisions are responsible for ensuring that programmatic health and safety concerns are addressed. They also are responsible for promoting a comprehensive health and safety program that covers special fields such as radiation protection, occupational medicine, industrial safety, industrial hygiene, criticality safety, waste management, and environmental protection and preservation.

ER Program Manager

The ER Program Manager is responsible for the overall health and safety program for ER Program activities. The program manager ensures that the health and safety programs are established, implemented, and supported.

Health and Safety Project Leader

The Health and Safety Project Leader (H&S PL) is responsible for updating and implementing the ER Program H&S Plan (Annex III of the IWP) and for reviewing operable unit H&S Plans. The H&S PL also is responsible for interfacing and coordinating with Laboratory personnel to use resources appropriate for the ER H&S program, and to ensure ER Program compliance with all applicable H&S policies and regulations. In conjunction with the Field

Teams Manager, the H&S PL oversees day-to-day health and safety activities in the field.

Operable Unit Project Leader

The Operable Unit Project Leader (OUPL) is responsible for the RCRA investigations concerning the assigned OU. Specific health and safety responsibilities include

- preparation, review, implementation, and revision of OU health and safety documents; and
- interface with the H&S PL to resolve health and safety concerns.

Field Team Leader

The Field Teams Leader is responsible for implementing the SAP, this H&S Project Plan, and the project-specific quality assurance project plan (QAPjP). Other health and safety responsibilities include:

- ensuring the health and safety of the field team members;
- assignment of a Site Safety Officer to ensure compliance with this site OU health and safety plan;
- familiarity with emergency response procedures and notification requirements and their implementation;
- acting as a backup to the site safety officer in the event of an emergency;
- coordination of field activities with Laboratory personnel and contractors, as needed;
- reading and complying with this OU health and safety plan; and
- ensuring day to day compliance of the health and safety procedures set forth in this plan.

TA-2 and TA-41 Site Safety Officer

In addition to the responsibilities outlined in Section 5.0 of Annex III of the IWP, the following responsibilities specific to TA-2 and TA-41 also will apply to the Site Safety Officer:

- reading and enforcing this OU health and safety plan;
- evaluating the potential hazards at the site;
- coordinating with WX-5 and INC-15 about activities and experiments affecting TA-2 and TA-41;

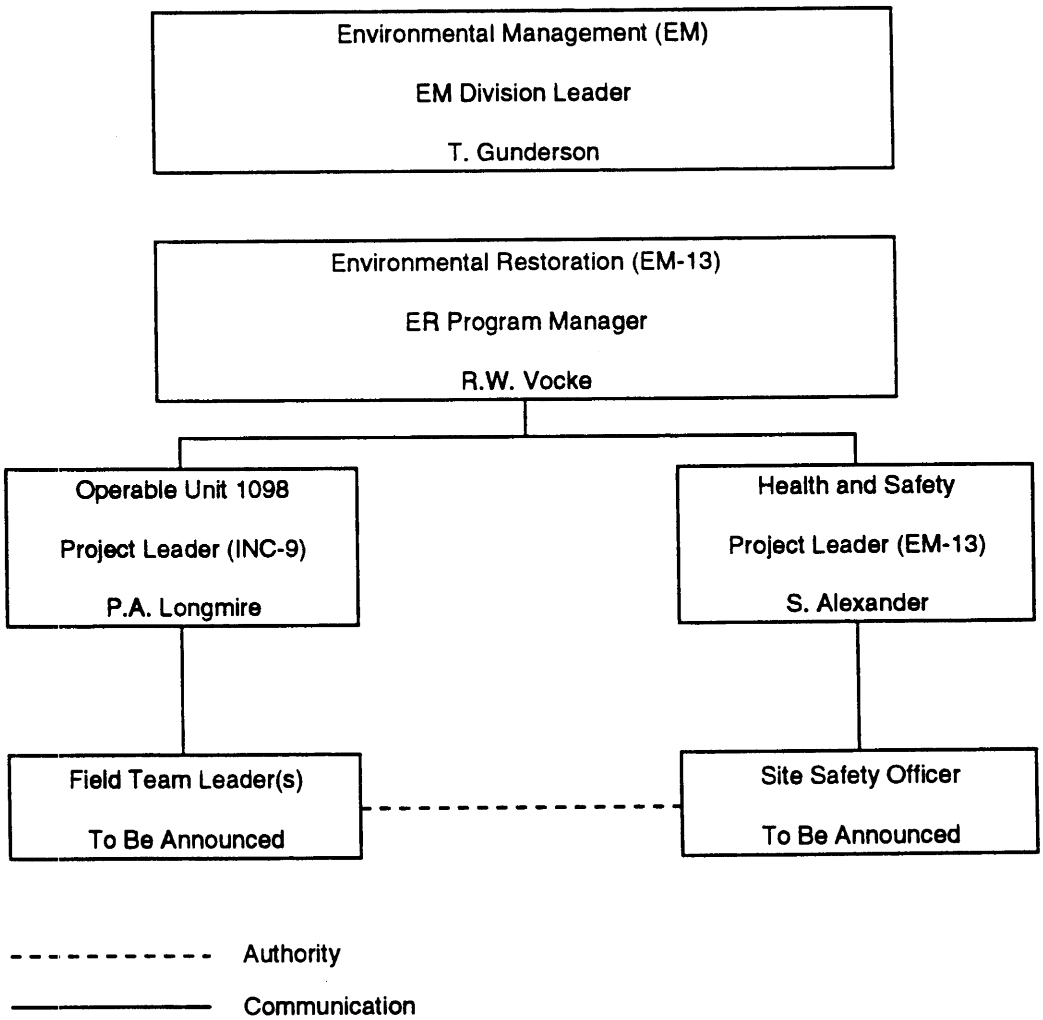


Figure III-1 Operable unit 1098 work organization chart showing health and safety responsibilities

- being informed about the results of sample analysis pertaining to health and safety as the ER site investigation and remediation work progresses;
- concurring with the Field Team Leader about the location of exclusion area boundaries;
- presenting safety briefings to workers;
- determining protective clothing requirements for workers;
- determining personal dosimetry requirements for workers;
- maintaining a current list of telephone numbers for emergency situations;
- having an operating radio transmitter/receiver in case telephone service is not available;
- maintaining an up-to-date copy of the H&S plan for work at the site;
- maintaining an up-to-date copy of the emergency plan and procedures for the site;
- establishing the safety requirements to be followed by visitors;
- providing visitors with a safety briefing;
- maintaining a logbook of workers and visitors within the exclusion area at a site;
- determining whether workers can perform their jobs safely under prevailing weather conditions;
- taking control of an emergency situation;
- ensuring that all personnel have been trained in the appropriate safety procedures and have read and understood this OU H&S Plan, and that all requirements are followed during OU activities;
- conducting daily health and safety briefings for the Field Team Leader and field team members;
- conducting daily health and safety audits of the work activities; and
- having authority and requiring that field be terminated if unsafe conditions develop or an imminent hazard is perceived.

Field Team Members

Field Team Members are responsible for conducting the assigned work in a manner that ensures that data collected are technically valid and legally defensible. They also are responsible for observing applicable health, safety, and environmental procedures; for using prescribed personal protective uipment; for promptly reporting accidents, injuries, and unsafe conditions; and for participating in required medical and biological monitoring programs.

2.3 Health and Safety Audits

Health and safety audits (including daily safety checks) will be performed during activities associated with this plan to ensure compliance with SOP-02.05, Safety Meetings and Inspections. The frequency of these audits will be at least quarterly with a minimum of one audit during the TA-2 and TA-41 remedial investigation.

Audits will be conducted by the Site Safety Officer or a competent designee. Results will be documented in the Health and Safety Checklist. The use of the checklist is outlined in ER Program SOP-01.01.02, Training and Medical Surveillance. The Laboratory HS and EM Deputy Division Leaders, ER Program Manager, ER H&S PL, and OU PL will receive copies of this report, which also will be retained at the work site. The Site Safety Officer will coordinate with the Field Team Leader to correct any deficiencies. OU readiness check lists must be completed before starting work.

The Laboratory HS and EM Divisions also may conduct health and safety audits separately or concurrently with the internal ER audits to ensure compliance with the Los Alamos Environmental Safety and Health Manual.

2.4 Variances from Health and Safety Requirements

Where special conditions exist, a written request for a variance from a specific health and safety requirement may be submitted by the Site Safety Officer to the Field Team Leader and H&S PL. If the Field Team Leader and H&S PL agree with the request, the request will be reviewed by the OU PL or a designee. As appropriate, higher levels of management may be consulted. The condition of the request will be evaluated and, if appropriate, a variance specifying the conditions under which the requirement may be modified will be granted in writing. The variance will become part of this H&S Plan.

3.0 Hazard Assessment and Personnel Protection Requirements

The following section is designed to identify potential hazards associated with the field activities at the TA-2 and TA-41 OU. Tables III-1 and III-2 (discussed later in this section) summarize the initial levels of personal protection anticipated at individual SWMUs and exposure limits for potential wastes at the TA-2 and TA-41 OU. Tables III-3 and III-4 summarize properties of radionuclides and suspected contaminants at the TA-2 and TA-41 OU. Specific hazard information of this type will be reviewed again before work is performed at that particular location. Training in the use of all required personal protection equipment will be provided and only trained an/or certified personnel will be allowed to use such equipment.

TABLE III-1
INITIAL LEVELS OF PROTECTION
ANTICIPATED FOR OU 1098 PRSs

PRS#	REQUIRED LEVELS OF PROTECTION		
	FIELD SURVEYS	SURFACE SAMPLING	SUBSURFACE SAMPLING
2-003	D	C-D	C-D
2-004	D	C-D	C-D
2-005	D	C-D	C-D
2-006	D	C-D	C-D
2-007	D	C-D	C-D
2-008	D	C-D	C-D
2-009	D	C-D	C-D
2-010	D	N/A	C-D
2-011	D	C-D	C-D
2-012	D	N/A	C-D
41-001	D	C-D	C-D
41-002	D	C-D	C-D
41-003	D	C-D	N/A

N/A *Not applicable, as samples are not proposed*

TABLE III-2
EXPOSURE LIMITS FOR SIGNIFICANT CONTAMINANTS AT OU 1098

CHEMICAL SUBSTANCE	OSAH PEL (mg/m^3)	OSHA CEILING (mg/m^3)	OSHA STEL (mg/m^3)	ACGIH TWA (mg/m^3)	ACGIH STEL (mg/m^3)
Chromium III	0.5[a]			0.5	
Chromium VI	0.1[b]			0.05	
Mercury		0.1			
Beryllium	0.002	0.005	0.025	0.002	
Cesium-173					
Cobalt-60					
Plutonium					
Strontium-90					
Technicium-99					
Tritium					
Uranium	0.25		0.6	0.2	0.6

[a] *As a chromous salt*
[b] *For chromium as chromic acid*

TABLE III-3
RADIOLOGICAL PROPERTIES OF ENVIRONMENTALLY SIGNIFICANT RADIONUCLIDES AT THE TA-2 and TA-41 OU

Radionuclide	Major/Mode of Decay (energy,MEV)	Daughter	DAC (μCi/mL)	Critical Organ	Radioactive Half-Life	Biological Half-Life (yr)	Monitoring Instrument
Cobalt-60	Gamma (1.17;1.33)	Ni-60	$1x10^{-8}$	GI tract, total body	5.2	0.026	GM
Plutonium-238	Alpha, (5.50; 5.46)	U-234	$3x10^{-12}$	Bone	86.4	200	Alpha scintillometer FIDLER
Plutonium-239	Alpha, (5.16; 5.11)	U-235	$2x10^{-12}$	Bone	$2.44x10^{4}$	200	Alpha scintillometer FIDLER
Plutonium-240	Alpha, (5.17; 5.12)	U-236	$2x10^{-12}$	Bone	6580	200	Alpha scintillometer FIDLER
Plutonium-241	Beta (0.021)	Am-241	$1x10^{-10}$	Bone	13.2	200	GM
Plutonium-242	Alpha (4.90;4.86)	U-238	$2x10^{-12}$	Bone	$3.79x10^{5}$	200	Alpha scintillometer
Americium-241	Alpha (5.49; 5.44)	Np-237	$2x10^{-12}$	Bone	458	200	Alpha scintillometer
Uranium-235	Alpha (4.40; 4.37)	Th-231	$2x10^{-11}$	Kidney	$7.1x10^{8}$	0.041	Alpha scintillometer
Uranium-238	Alpha (4.15; 4.20)	Th-234	$2x10^{-11}$	Kidney	$4.51x10^{9}$	0.041	Alpha scintillometer
Tritium	Beta	He-3	$2x10^{-5}$	Total body tissue	12.3	0.033	Liquid scintillometer
Cesium-137	Beta (0.512)	Ba-137	$7x10^{-8}$	Total body	30.0	0.19	GM
Strontium-90	Beta (0.546)	Y-90	$2x10^{-9}$	Bone	27.7	49	GM

DAC - derived air concentration (DOE draft Order 5480.11)
Critical organ - that part of the body that is most susceptible to radiation damage under the specific conditions being considered.
GM - Geiger-Muller detector
Half lives are from the Los Alamos Handbook of Radiation Monitoring (1970).

TABLE III-4
SUSPECTED CHEMICAL AND RADIOLOGICAL SUBSTANCES AT PRSs WITHIN OU 1098

CESIUM-137
STRONTIUM-90
TECHNETIUM-99
URANIUM (TOTAL)
PLUTONIUM (TOTAL)
COBALT-60
TRITIUM
CHROMIUM III
CHROMIUM VI
MERCURY
UNKNOWN VOLATILE ORGANIC COMPOUNDS
UNKNOWN SEMIVOLATILE ORGANIC COMPOUNDS
UNKNOWN METALS

3.1 Identification of Hazards and Risk Analysis

The Site Safety Officer will monitor field conditions and personnel exposure to physical, chemical, biological, and radiological hazards. If a previously unidentified hazard is discovered, the Site Safety Officer will contact the Field Teams Manager and the H&S PL and address the hazard. A safety analysis will be performed on the hazard to identify the potential harm, the likelihood of occurrence, and measures to reduce the risk. The analysis will then be written and added to this plan in the form of an amendment. The amendment must be reviewed and approved by the H&S PL and OU PL and signed by appropriate field team leaders and field team members, showing that they have knowledge of the newly identified hazard.

3.1.1 Physical Hazards

Injuries occur most often from exposure to physical hazards. These injuries range from minor cuts and bruises to fatalities caused by serious unexpected events. The severity of these events may be controlled using sound inspection and monitoring practices. Therefore, this section is dedicated to outlining the potential physical hazards, as well as some preventive measures, for this RFI.

Noise

Constant exposure to noise may have an adverse affect on the ability of personnel to hear and understand normal speech. Prior to 1979, the medical profession had defined hearing impairment as an average hearing threshold level in excess of 25 decibels (dB) at 500, 1,000, 2,000, and 3,000 hertz (Hz). Therefore, limits have been established to prevent hearing loss in excess of this level. Some activities during the TA-2 and TA-41 RFI have the potential to exceed these levels (e.g., operation of drill rigs and and other heavy machinery).

The following are standards established by ACGIH for noise exposure:

Duration/day in hours	Sound level in dBA
16	80
8	85
4	90
2	95
1	100
.5	105
.25	110
.125	115

Because decibels are logarithmic units, they cannot be added or subtracted. In fact, if the intensity of a noise is doubled, there will only be a corresponding increase of three decibels. The following are examples of some common noises and the associated levels: an average residence is approximately 50 dB, conversational speech is 60 dB, a very noisy restaurant is 80 dB, a subway is 90 db, and a jet plane is 120 dB.

If a sound level meter is not available for monitoring noise, a simple test will identify levels above 85 db. If at an arms length (3 ft) normal conversation is not possible, engineering controls, administrative controls, or personnel protective equipment should be implemented.

Pinch Points

Pinch points are generally associated with activities utilizing tools or equipment with turning or moving parts such as a drill rig, backhoe, or even small hand tools. The moving parts may even be equipped with guards. If this is the case, periodic inspections must be performed to assure the guards have not been removed. The guards are generally removed by field personnel when it slows the progress of the operator or makes it difficult to use. When inspections show that guards have been removed, the tool or equipment should be tagged and not used until such time as the guard has been replaced.

In larger equipment, hydraulics mechanisms and tools are encountered more often. Guarding of these hazardous areas is more difficult. Additionally, the severity of injury is much greater with hydraulics due to amount of force created with hydraulically driven machinery. Initial inspections become more important, identifying areas of concern and informing field team members of the potential hazards. The most efficient and comprehensive procedure for inspections is that they be performed by a competent person who has experience with that particular piece of machinery. Most equipment can be inspected in less than 30 minutes using a check list. The Site Safety Officer will obtain a check list before the start of field activities.

OSHA requires that most equipment be inspected on a yearly basis. This inspection is generally conducted by the manufacturer, representative, or dealer. These inspections are to be documented and kept with the piece of equipment. This ensures that the equipment is properly maintained and free of any parts which could potentially become hazardous to the operator or bystanders.

Slip, Trip, and Fall

Injuries from slip, trip, and fall hazards are the most common around drill rigs, backhoe operations, and uneven terrain. These hazards occur due to either poor housekeeping, bad weather conditions, or the uneven terrain caused by soil excavation. Procedures may be developed to reduce the likelihood of slip, trip, and fall injuries. The Site Safety Officer will ensure that good housekeeping practices are followed. This includes the following: keeping tools stored in an accessible but out of the way place; keeping the work area free of soil piles to as great a degree as possible; reminding personnel to be aware of uneven terrain; keeping personnel at least 5 ft from the mesa edge; and marking trench and borehole boundaries.

Explosion/Fire/Oxygen Deficiency

Significant potential for flammable, or combustible, and oxygen deficient atmospheres is not anticipated during drilling, trenching, and tank sampling at the TA-2 and TA-41 OU.

Any work with flammable materials will be done according to LANL Administrative Requirement 6-5, Flammable and Combustible Liquids, and Technical Bulletins 601 (Flammable Liquids), 602 (Flammable Gases), 603 (Solvents), 604 (Epoxies). The ER Program SOP, Health and Safety Monitoring of Combustible Gas Levels, also will be followed.

As necessary, measurements of explosion potential will be made in enclosed spaces or in boreholes using a combustible gas indicator (CGI)/oxygen meter. If the CGI indicator shows concentrations greater than 20% of the LEL (lower explosive limit), activities in that area will cease. The work area will be evacuated and the appropriate safety measures will be implemented. Continued CGI readings will be made by the site safety officer to determine the appropriate time for return to the area.

Oxygen levels will be measured in enclosed or confined spaces and in areas that are not ventilated frequently (e.g., low-lying areas). Air-purifying respirators will be worn when oxygen concentrations are below 19% and 21%. If oxygen levels fall below 19%, the area must be evacuated or supplied air respirators must be furnished to personnel in these areas.

Oxygen rich atmospheres create an increased potential for fires. Therefore, if levels exceed 25%, the area will also be evacuated. If an evacuation becomes necessary, the area will be ventilated, and the site safety officer will continue monitoring oxygen levels. The Site Safety Officer will determine when it is safe for personnel to return and resume work.

Heat Stress

Heat stress occurs when the body's physiological processes fail to maintain a normal body temperature because of excess heat. This failure is enhanced when impervious clothing is worn during hot summer months. The best cure for heat stress is prevention. Acclimation to heat is the most effective method, but drinking plenty of water, avoiding alcohol consumption, and frequent cooling breaks are also effective. When the body cooling system starts failing, a number of symptoms begin to occur. Heat stress monitoring will be performed according to ER Program SOP 02.06, Heat and Cold Stress and Natural Hazards. Listed below are the physical reactions that can occur, ranging from mild to fatal.

Heat-Related Illness

- Heat Rash - caused by exposure to heat and humid air aggravated by changing clothes. Decreases the ability to tolerate heat and becomes a nuisance. If heat rashes occur, it is best to keep the area cool and dry.
- Heat Cramps - caused by profuse sweating with inadequate fluid intake and chemical replacement (especially salts and potassium). Signs: muscle spasms and pain in the extremities and abdomen. If heat cramps occur, it is best to drink plenty of fluids, (water is best), add slightly more salt to food, and replace potassium by eating bananas.

- Heat Exhaustion - caused by an increased heat stress to the body and an inability of various organs to meet the increased demand to cool the body. Signs: shallow breathing; pallor; cool, moist skin; profuse sweating; dizziness; and lassitude. If heat exhaustion occurs it is best to get the person to a cool shady area (not in air conditioning) and allow the body to slowly cool and give plenty of fluids. Depending on the severity, one should wait a certain period of time before returning to the hot area.

- Heat Stroke - the most severe of the heat-related injuries occurs when the body's cooling system shuts down completely Signs: red, hot, dry skin; lack of perspiration; nausea; dizziness and confusion; strong rapid pulse; coma. The body must be cooled immediately and sent to the nearest hospital for immediate medical attention to prevent severe injury and/or death.

Work/Rest Schedule

When working in protective clothing, the following guidelines for calculating work/rest schedules should be used.

Calculate the adjusted temperature as follows:

T(adjusted) = T(actual) x (13 x sunshine fraction)

100% sunshine	=	no cloud cover	=	1.00
75% sunshine	=	25% cloud cover	=	0.75
50% sunshine	=	50% cloud cover	=	0.50
25% sunshine	=	75% cloud cover	=	0.25
0% sunshine	=	100% cloud cover	=	0.00

Adjusted Temperature	Active Work Time (min/hr)
75° or less	50
80	45
85	40
90	35
95	30
100	20
105	10
110	0

Cold Exposure

Persons working outdoors in temperatures at or below freezing can suffer from cold-related injuries. Exposure to extreme cold for a short periods of time can cause severe injury to the body surface or can result in profound generalized cooling (hypothermia), which can lead cause death in extreme cases. Body areas that have high surface area to volume ratios, such as fingers, toes, and ears, are the most susceptible.

Cold Stress Monitoring will be performed according to ER Program SOP 02.06, Heat and Cold Stress and Natural Hazards.

Cold Related Illness

- Frost nip or incipient frostbite - characterized by a sudden whitening of the skin. If this occurs, warm hands slowly and get the victim into warm dry clothes.
- Superficial frostbite - causes skin to become very waxy or white and superficially firm but flexible underneath. If frostbite occurs, get the victim indoors and place the hands in warm 100–105°) water. Do not rub the affected part. Get the victim to medical attention as soon as possible after the affected part has been warmed.
- Deep frostbite - characterized by cold, pale, solid skin tissue; also may be blistered. Blisters should not be popped, and victim should be warmed in the same manner as above.
- Systemic hypothermia - caused by exposure to freezing or rapidly dropping temperatures. Symptoms are usually exhibited in five stages: 1) shivering; 2) apathy, listlessness, sleepiness, and (sometimes) rapid cooling of the body to less than 95° F; 3) unconsciousness, glassy stare, slow pulse, and slow respirations; 4) freezing of the extremities; and 5) death. Get the victim to a warm area as soon as possible and into warm dry clothing, and transfer to medical attention as soon as possible.

The best cure for cold-related injuries is prevention, which includes dressing in warm, insulated garments. If the potential exists for getting wet, wear wool clothing; take frequent warming breaks.

Electric Shock

Personnel working at TA-2 and TA-41 have the potential for exposure to electrical shock during drilling, trenching, and sampling activities. The source of this hazard may be from overhead and underground utilities, use of portable equipment, and digging and/or hand augering into underground utilities. Compliance with the following requirements will significantly reduce the chance of personnel exposure to electrical shock.

1. Only qualified and licensed personnel will be allowed to operate drilling, trenching or sampling equipment.
2. Heavy equipment and energized tools will be inspected by a competent person before use and will meet all applicable local, state, and federal standards.
3. Installed overhead electrical power lines will conform to the table below. While in use, drill rigs will maintain a 35-ft minimum distance from overhead power lines.
4. In transit, with the boom lowered, the closest approach to a power line will be 16 ft.

5. All areas to be drilled will be cleared through the LANL utilities manager before drilling activities begin.
6. Any cord with the grounding stem removed will be taken out of service and repaired or thrown away.
7. Ground fault interrupters will be used on all portable electrical equipment.

3.1.2 Chemical Hazards

Tables III-1 through III-4 list suspected hazards and health and safety related characteristics by location for the TA-2 and TA-41- OU. Also listed in the tables are the initial levels of required personal protection. Chemical exposure hazards at the TA-2 and TA-41 OU include inhalation and ingestion of nonradioactive substances. Dermal hazard is not significant for metals in general, provided that the metals are not present as organic complexes. If unexpected chemical contaminants are identified during the RFI, they will be added to the list of chemical contaminants of concern. The site safety officer will be responsible for adding chemicals to this table and for notifying field personnel as needed.

Table III-2 summarizes the available exposure standards and guidelines for the chemical hazards anticipated to occur at the site.

3.1.3 Radiological Hazards

Radionuclides that are probably present at the TA-2 and TA-41 OU include ^{238}Pu, $^{239/240}Pu$, and $^{235/238}U$. Tritium, ^{137}Cs, ^{90}Sr, and other fission products are present in much smaller amounts. Table III-3 summarizes health and safety information for these radionuclides.

There are three principal pathways whereby on-site individuals may be exposed to radioactivity during field investigations at TA-2 and TA-41:

- inhalation or ingestion of radionuclide particulates;
- dermal absorption of radionuclide particulates through wounds; and
- exposure to direct radiation from contaminated materials.

Soils will be screened in accordance with the ER SOP 02.10, Radiation Protection. If new radionuclides are discovered at the TA-2 and TA-41 OU, they will be added to the list for the OU. The Site Safety Officer will be responsible for adding for notifying field personnel as needed.

3.1.4 Biological Hazards

Biological hazards will likely be encountered in some of the areas of TA-2 and TA-41. Mosquitoes, ticks, spiders, and rodents, including mice and rats, are likely t0 be encountered. In addition, rattlesnakes may be encountered, especially near brushy or rocky areas and near structures and debris. Workers who regularly walk through such areas should wear high-top boots or snake leggings and have the grass mowed (where appropriate) to control rodents and snakes.

If snake bite occurs, the Emergency Medical System (EMS) should be notified immediately. The only first aid treatment that should be administered is an ice or a cold pack placed just above the affected area to slow blood flow. The victim's heart rate should be kept as slow as possible by remaining as still and calm as possible. If workers are bitten by insects, first aid creams may be applied by the Site Safety Officer to ease the symptoms caused by the bite. If personnel are bitten by a rodent, attempts should be made to obtain the animal, and medical assistance should be sought as soon as possible.

3.1.5 Traffic

Traffic control will be maintained in and around the job site at all times to avoid personnel injuries and prevent equipment damage. Work areas regularly occupied by pedestrians will be delineated so that vehicle equipment operators will not encounter them. Delineation will be accomplished using barricades, warning signs, warning lights, traffic cones, and so forth.

If work takes place in or near heavy traffic areas, these areas will be appropriately marked with the aforementioned devices as necessary to protect personnel. Personnel will wear fluorescent orange and/or reflective clothing, vests, and so forth when working in and around traffic areas.

Sufficient parking will be provided. Vehicles not being actively used will be parked so that they do not interfere with traffic. When a vehicle is being maneuvered in a confined area with limited visibility, personnel positioned outside the vehicle will give assistance to the operator.

Pedestrian and civilian traffic have the right-of-way on site. Personnel on foot will be careful when around heavy equipment and when walking near roads. Ground personnel should always make eye contact and wait for a signal to proceed before passing close to or in front of operating equipment or moving vehicles.

All drivers and operators will adhere to speed limits, signs, and road markings. Equipment operators and ground personnel will be especially careful when air-line respirators are in use because of the potential for injury if an air line were to become tangled in the track or wheel of a vehicle or equipment. Under no circumstances will breathing air systems supplying air to the respirators of ground employees be attached to vehicles or equipment.

3.1.6 Topography

To reduce hazards associated with topography, the Site Safety Officer will inspect each site for potential hazards. Some of these hazards can be alleviated, such as removing any obstacles in immediate work areas, clearing icy surfaces, and placing tools in an accessible but protected area. Boundaries surrounding excavations, trenches, and boreholes will be marked. In general field team members conducting site activities near the edge of a mesa will not be permitted to work closer to the edge than 5 ft. Barrier tape will be used to designate this restricted area. All field team members will be informed of the potentially hazardous locations as well as of the controls. Field team members also will be expected to observe good housekeeping practices for the duration of the work in each area.

3.1.7 Lightning

Lightning usually strikes the tallest object in an area and takes the least conductive route to ground. Buildings or vehicles provide better protection than being in the open. A large building with a metal structure is the safest because electric current will run along the outside metal frame and into the ground. An automobile with a metal roof serves the same purpose; however, convertibles or fabric-topped cars are not safe because lightning can burn through the fabric.

Wood or brick buildings that are not protected by lightning rods have high potential for a strike which travels down natural conductors such as wiring or pipes. Any contact with an undergrounded conductor can be dangerous. Telephones, faucet's, electrical equipment, and metal fences are examples of ungrounded conductors.

A person in the open during a lightning storm should crouch to avoid being the tallest object. A tingling sensation or hair standing on end signal that lightning is about to strike and that a crouching position must be assumed immediately. The safest crouching position is to place the hands on the knees and to keep the knees and feet together while remaining as low as possible. Stretching out flat on damp soil could cause the body to attract current running into the ground from a nearby tree. Keeping feet and knees spread or placing the hands on the ground could complete a circuit and cause high-voltage current to run throughout the body.

A grove of trees affords more protection than remaining in the open or taking shelter under a single tree. Lower ground is also safer; however, ditches and ravines in sizable drainage areas present the danger of being carried away by flood waters.

Side strikes injure more people than direct strikes. Side strikes are caused when electric current jumps from its present conductor to a more effective conductor. Since the human body is a better conductor than a tree trunk; a person should stay 6 ft from a tree to avoid a side strike. A group of people taking shelter under a grove of trees should stand 6 ft apart to avoid side strikes from one person to another.

The force of electrical current temporarily disrupts the nervous system. Therefore, even if breathing and heartbeat have stopped, a lightning victim may not be dead. Many victims can be revived by artificial respiration and CPR. Once the lightning flash is over, current is no longer running through the body and it is safe to touch a lightning victim. Even a victim who seems only slightly stunned should receive immediate medical attention because internal organs may be damaged.

3.2 Task-by-task Risk Analysis

According to OSHA 1910.120, a task-by-task risk analysis is required. These tasks are related to specific operations or activities in the field investigation. The preceding section identifies the physical, chemical, radiological, and biological hazards known or suspected to be present at the TA-2 and TA-41 OU. This section is designed to discuss many of the proposed tasks and identify which of the hazards apply and estimate the likelihood of exposure. Sections 3.3, 3.4, and 3.5 of this Annex identify methods for eliminating or reducing the potential exposure to the hazards associated with these tasks.

Task: Drilling

Potential for Exposure: High

Associated Hazards: In drilling, there is a possibility for serious physical injury. The injuries may range from bruised and cut fingers to death. Working around a drill rig allows for entanglement and pinch points in many parts of the rig. These injuries are generally minor but have the potential for amputating fingers. Other severe injuries may occur from failure of wire rope under extreme stress. If the rope breaks under high tension, it will act as a whip, which could decapitate workers in the area.

Chemical and radiological hazards also are created when drilling disturbs or penetrates a contaminated soil.

Task: Hand Augering

Potential for Exposure: Moderate

Associated Hazards: The hazards for hand augering are similar to those of drilling. The potential for contact with contaminated soils is enhanced, and this operation will have a tendency to stir up dust. Powered hand augers still present hazards of operator entanglement and pinch points but to a lesser degree. With a nonpowered hand auger, the probability of physical injury is reduced greatly.

Task: Trenching

Potential for Exposure: High

Associated Hazards: The main physical hazards associated with trenching operations derive from the use of heavy equipment and the potential for cave-ins. Operators of heavy equipment are trained to be aware of personnel around the area. However, operators can be distracted or lose concentration. Therefore, personnel must be alert while backhoes are operating. Cave-ins occur when the wall of the excavation cannot bear the load and collapse. Cave-ins can occur in trenches of all depths, but this hazard can be reduced substantially by limiting trench depths to 5 ft or less. Physical injuries, as a result of cave-ins, range in severity with the most severe being death.

Chemical/radiological hazards may be encountered while trenching is in progress and the most concentrated personnel exposure may occur from the resuspension of contaminated dust. Air monitoring at this time is critical. In contrast, the accumulation of organic vapors inside the trench will most likely occur after the trench has been completed, but this is not expected to be significant at the TA-2 and TA-41 OU due to the lack of significant organic contamination.

3.3 Engineering Controls

OSHA regulations state that when possible, engineering controls should be utilized as the first line of defense for protecting workers from hazards. Engineering controls are mechanical means for reducing the hazard to workers, such as the guarding of moving parts on machinery and tools or utilizing a ventilation hood in a lab to remove contaminant vapors. Unfortunately, engineering controls are not as easily accomplished in an uncontrollable environment, such as outdoors. However, the following are some possibilities that can be utilized while working in the field.

3.3.1 Engineering Controls For Airborne Dust

Airborne dust can be a hazard in two situations: 1) nuisance dust for which standards have been established at 15 mg/m^3; and 2) attachment of radionuclides and/or hazardous substances to soil particles. In either case, engineering controls may have limited use when airborne dust becomes a hazard.

During drilling or any other activity where localized dust is being generated, a small garden sprayer of water may be used to wet the soil enough to suppress the dust. Although this technique can be effective in some cases, sprayers do not discharge a large amount of water and spraying must be repeated often to maintain effectiveness.

Where there are high winds in a large, dusty area with little or no vegetation, small quantities of water are not effective. In this instance, a water truck may be used to wet the area enough to suppress the dust. This also will require frequently repeated applications to be effective.

3.3.2 Engineering Controls For Airborne Volatiles

Drilling and trenching activities may produce gases, fumes or mists. These may be easily inhaled or ingested by workers with no protection. Engineering controls may be implemented to reduce the exposure to these hazards. Wind can remove toxic vapors from the work area with careful positioning of equipment, such as a drill rig. For example, a rig might be positioned so that the prevailing wind blows towards the side of the rig. This allows the vapors to be blown away from personnel behind the rig and prevents the vapors from collecting under the rig, and allows for an upwind approach of workers not performing duties directly related to the drilling.

Another method is the use of ventilation by mechanical means, which may not be as effective as wind in open areas, but generally is more practical in closed or confined spaces. Fans may be used to remove vapors or even to supplement a gusting wind. The most effective use of ventilation using mechanical equipment is for sampling tanks or performing confined space work. The fan or other mechanical device may be attached to a large hose to either push, or more effectively pull, the contaminant from the confined space. Each has its advantages. Pulling the air from the space is more effective at removing the vapors, whereas forcing air into the confined area provides for better assurance of acceptable oxygen levels from ambient air. This procedure has been used effectively by fire departments, who may be consulted for information on the most effective method for each situation.

3.3.3 Engineering Controls For Noise

Engineering controls for noise are difficult to implement in uncontrolled environments. Drilling and trenching is likely to produce the highest range of noise levels. Fortunately, noise produced from drilling is generated by the engine itself. On most rigs, the highest range of noise is encountered on the side of the rig, while drillers perform a majority of their work behind the rig. This is because the front and rear of the rig's engine often are covered, whereas the sides are left open to allow cooling of the engine. If noise levels reach 90 dB, additional barriers should be utilized, if possible, to reduce excessive noise exposure.

3.3.4 Engineering Controls For Trenching

Trenching often presents field personnel with hazards associated with slip, trip, fall, and crushing type hazards. In most cases, entry into an excavation deeper than 5 ft is avoided whenever possible. However, it is sometimes necessary to enter these trenches to obtain the needed information. OSHA has developed regulations for trenches and excavations. Included in the regulations are engineering controls for the prevention of cave-ins. These controls include the addition of shoring, sloping, and benching to the excavation. Benching is a systematic series of steps dug around the excavation at a specified angle of repose. The angle of repose is based on the type of soil present. Sloping is a similar system of stabilizing soil but is performed without the steps. Again the angle of repose is determined by the type of soil. This method is generally used for medium-sized excavations, such as a tank removal. In general, neither of these soil stabilization methods are convenient techniques for exploratory trenches. The last method that OSHA suggests is shoring. Shoring is available in many different varieties, but the basic 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. One drawback to utilizing shoring is that it is expensive and time-consuming, especially for a trench that is only scheduled to be open for 1 or 2 days. Administrative controls and personnel protective systems are more desirable and realistic for the RFI work plan at TA-2 and TA-41.

3.3.5 Engineering Controls For Drilling

Working with and around drill rigs presents workers with many hazards, due to the number of moving parts and the power associated with the equipment. Engineering controls for drilling operations include the installation of guarding where possible to prevent crushing injuries and, more importantly, an inspection program to insure replacement of worn or broken parts. As stated earlier, this should be performed at the beginning of the job and on a regular basis during the project.

3.4 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 to which personnel are exposed to a hazard. Examples include the amount of time a worker spends in a hazardous area or the distance to a hazardous area. Such controls can be instituted easily in most cases and are effective measures in decreasing personnel exposure.

3.4.1 Administrative Controls For Airborne Chemical and Radiological Hazards

Chemical and radiological hazards are to be monitored during the performance of duties in the contaminated zone. If concentration of radionuclides or toxic materials exceeds the limits established in this plan, personnel may be removed from the area until natural or mechanical ventilation brings the levels to background. This method would prevent the necessity of using personnel protective equipment. In addition, personnel should enter the contaminated zone only when required. This method complies with DOE's policy of maintaining exposures As Low As Reasonably Achievable (ALARA).

Because the exposure limits consider the average amount of exposure during an 8-hr day, personnel exposed at a higher concentration for a portion of the day may conduct tasks in an uncontaminated area to lower the average for the day. For chemical contaminants, those higher concentrations must be lower than the Immediately Dangerous to Life and Health (IDLH) concentration and the TLV Ceiling limits.

3.4.2 Administrative Controls for Noise

Administrative controls for noise include both time and distance. The principle is very much like the controls used for both airborne chemical and radiological hazards. In Section 3.1.1 of this Annex, noise is discussed, and guidelines on administrative controls established by ACGIH are listed in a table. The basic idea is to increase the distance between the noise and the worker or decrease the time spent at the source. Sound pressure or intensity follows the inverse square law where, as the distance from the source increases, the sound level decreases as the square of the distance. For example, if sound levels at 10 ft from the source are 100 dB and the distance (20 ft) from the source is doubled, the sound level drops to 94 dB; at 30 ft, or triple the distance to the source, the sound level drops to 90 dB.

If reduction of exposure time or distance is not possible, personal protective equipment must be donned to protect workers.

3.4.3 Administrative Controls for Trenching

Administrative controls are the most effective methods for reducing the hazards of trench investigations which may be proposed for the TA-2 and TA-41 RFI. These administrative controls were established by OSHA during the development of the regulations. The basic philosophy behind the administrative controls for trenching is not to create a hazardous condition to begin with. All trenches should be excavated to a depth less than 5 ft, where possible. However, monitoring inside the trench and means of egress (every 25 ft) must be implemented at a depth of 4 ft. Soil piles, tools, and other debris must be stored at least 2 ft from the edge of the excavation. All excavations must be marked when the area is not occupied to restrict access.

Even though standard procedures are followed, accidents may still occur due to human error or other circumstances. A backhoe operator may not see or know if there are workers in the trench. Therefore, any time there are personnel in the trench the operator must shut down the equipment until the excavation has been evacuated. Inspections should be made by a competent person before any field team member is allowed to enter the excavation. Additionally, personnel are required to be aware of conditions inside the trench as well as the activities going on outside the excavation.

3.4.4 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 around work area nears the edge of the mesa. Additionally, personnel working should not get closer than 5 ft to the edge unless close approach is really required. If necessary, bannerguard will be used to delineate this restricted area.

3.5 Personnel Protective Equipment and Systems

In the event that engineering and administrative controls are not suitable, personnel protective equipment should be used as a last line of defense against hazards. This equipment may be used alone or as a supplement to existing safety systems and to enhance the degree of safety for workers. Personnel protective equipment is a garment or apparatus that is worn by field team members to protect them from a certain type or group of hazards. Some examples of personal protective equipment are, TYVEK, hard hat, gloves, safety harness, respirator, etc. The maintenance, inspection, procedures and training for personal protective equipment usage will follow the H&S Program of the organization that implements this plan. The following sections discuss the protective equipment or systems to be used in certain situations.

3.5.1 Protection Levels and Protective Clothing

The U.S. EPA has established four levels of protection for workers entering potentially hazardous sites. At many of the SWMUs at the TA-2 and TA-41 OU, the contaminants have been identified. Therefore, an assessment of personal protective levels has been made based on each of the contaminants, investigation activities, and the areas to be investigated (see Table III-1). Action levels for upgrades in levels of protection are based on those factors and are given in Section 3.5.2, Action Levels for Upgrade in Protection.

The majority of site characterization will begin in modified level D protection. In certain cases, Level C may be prescribed due to the amount or toxicity of the contaminants present. The use of Level B protection is not anticipated. Personnel entering contaminated zones are required to meet the level of protection designated for that area. The levels of protection and the minimum equipment allowed for each of the levels of protection are as follows:

Level C protection will include the following:

- full face, air purifying respirator (MSHA/NIOSH-approved) with cartridges or canisters capable of filtering contaminants of concern;
- contaminant-resistant clothing suitable for protection against the hazards of concern;
- inner glove (pvc, latex, or nitrile);
- rubber outer gloves providing an effective barrier between the wearer and contamination;
- steel-toed safety boots made of rubber or leather when disposable boot covers are donned; and
- hard hat, safety glasses, and hearing protection as needed.

Modified Level D protection will include the following:

- cloth or TYVEK coveralls, or work uniform;
- rubber or leather outer gloves providing the best protection for the activity being performed;
- steel-toed safety boots and optional boot covers as needed; and
- hard hat, safety glasses, and hearing protection as needed.

The field team leaders are required to provide this equipment to each of their field team members.

TA-2 and TA-41 RFI activities will be conducted according to LANL Administrative Requirement 12-1, Personal Protective Equipment; and LANL

Technical Bulletins 1201, Eye and Face Protection; 1202, Protective Clothing; and 1203, Respiratory Protective Equipment.

3.5.2 Action Levels for Upgrade in Protection

Monitoring instruments are to be used in conjunction with lab analysis to establish the exposure levels of field team members. These instruments will monitor for radiation, volatile organics, corrosives, flammable vapors, and particulates. Action levels will be established based on the results obtained during SWMU-specific monitoring. In some instances, laboratory screening and analysis with quick turn around will be necessary to determine the actual level of the specific chemical contaminant in air. For instance, there are no direct reading instruments for metals other than mercury, but there is a real time aerosol monitor (RAM) that determines the amount of respirable dust present in the breathing zone. Soil concentrations of metals of concern from laboratory analyses thus can be used to calculate the total concentration in air, based on a total particulate reading from the RAM.

Results of the calculations will be confirmed with air sampling. Air sampling during the TA-2 and TA-41 RFI will be used predominantly for determining alpha contamination in air. The organization selected to implement the monitoring will supply the method of maintenance and calibration for the specific instruments to be used.

The monitoring instruments to be used during this investigation are as follows:

Photoionization Detector (PID) and Flame Ionization Detectors (FID)

Photoionization and flame ionization detectors are used to monitor total organic vapors. A description of these detectors may be found in Section 9.3 of Annex III (H&S Plan) of the IWP.

Combustible Gas Indicator (CGI)

A CGI is used to monitor the concentration of flammable gases and vapors. A description of the CGI may be found in Section 9.3 of Annex III (H&S Plan) of the IWP.

Oxygen Meter

Portable oxygen meters are used to measure ambient oxygen concentrations in confined spaces or areas. A description of the oxygen meter may be found in Section 9.3 of Annex III (H&S Plan) of the IWP.

Real Time Aerosol Monitor

Real time aerosol monitors are designed to monitor respirable particulates (<10 microns). These instruments measure reflected light, which is converted to units of mg/m^3. These measurements are useful if there are known concentrations in soil of alpha contaminants, particulates and metals. Soil samples will be submitted for the laboratory analysis, and the results will be used to determine action levels for the contaminants that are present.

Colorimetric Indicator Tubes

Colorimetric indicator tubes may be used to quickly measure the approximate concentrations of specific vapors or gases. A description of colorimetric indicators is found in Section 9.3 of Annex III (H&S Plan)of the IWP.

High- and Low-Volume Air Samplers

High- and low-volume air samplers are used to collect particulates on a filter that is analyzed subsequently to determine the types and concentrations of airborne contaminants (e.g., alpha contamination). A description of air samplers is found in Section 9.3 of Annex III (H&S Plan) of the IWP.

Radiation Survey Meters

A variety of radiation survey meters will be used in the TA-2 and TA-41 RFI to determine the levels to which workers are exposed to radiation. Alpha scintillometers will be used to screen cores and personnel leaving the contaminated zone. A μR meter or a Gieger-Muller tube detector will be used to establish gamma (and beta) exposure to field team members. In addition, Thermoluminescent Dosimeters (TLDs) will be worn by all workers while at TA-2 and TA-41 SWMUs.

Action Levels

The following guidelines are to be used at SWMU locations of the TA-2 and TA-41 OU. ER Program SOPs describe measuring procedures and frequency of monitoring.

Organics

Organic contaminant levels at TA-2 and TA-41 SWMUs have been estimated from the historical information gathered during the preparation of this plan. In general, organic contaminants are expected to be at or near background levels. If field monitoring or laboratory analysis proves this conclusion to be unfounded, appropriate guidelines will be instituted to ensure health and safety of workers.

Combustible Vapors

As appropriate, the CGI will be used to monitor for combustible atmospheres during drilling and trenching. One-minute readings will be used for boreholes and trenches to give the instruments time to equilibrate. At 20% of the LEL, personnel will be evacuated and engineering controls will be utilized to reduce the concentration of combustible vapors. Personnel may resume work when levels drop below 10% of the LEL.

Particulates, Metals, PCBs, and Alpha Contamination

As appropriate, real-time aerosol monitors will be used in conjunction with laboratory data to determine the concentrations of contaminants in air. Samples will be obtained to determine the amount of contaminants in soil and an action level will be calculated for that particular work area.

3.5.3 Safety Systems and Equipment

A variety of safety equipment will be used to protect personnel from physical hazards and to minimize exposure to hazardous chemicals and radionuclides during field activities at TA-2 and TA-41.

Hearing protection - If noise levels are above 85 dB and both engineering and administrative controls are not practical, hearing protection will be required. There are two basic types of hearing protection that are available: 1) disposable and reusable ear plugs, and 2) ear muffs. Ear plugs may reduce noise levels 25-30 dB and ear muffs 35-40 db if worn properly. Product information for specific protective devices will be used to determine the effective noise reduction rating.

Trench protection - Trench boxes and trench shields have been developed for trench operations where shoring, benching, and sloping are not feasible. A trench box or shield is a box constructed from a strong metal or wood wide enough for workers to move about inside and perform their duties. OSHA regulations specify criteria for the trench box to be considered safe. The trench box is placed in the trench and attached to a backhoe so that it may be pulled along as the work progresses. This type of system is used often in the installation of water systems. The walls of the trench may not be viewed from the box, and protection is voided when workers leave the box.

Fire Protection - Fire extinguishers are classed by the type of fire it is designed to extinguish, but may be effective for more than one class of fire.

Class A - ordinary combustible materials (wood, paper, and textiles)

Class B - flammable liquids (oil, grease, and paint)

Class C - electrical fires

Class D - metals capable of rapid oxidation (magnesium, sodium, zinc, aluminum, uranium, and zirconium)

Other Safety Equipment - In addition to the personnel protective devices described above, other safety equipment may be used as needed. LANL Administrative Requirement 12-2, Seatbelts, will be followed. Warming and cooling equipment may be necessary to minimize stress from climatic conditions. Emergency equipment will also be necessary for immediate response and emergency treatment. Additionally, the location of such equipment must be clearly marked and personnel should know the location and be trained in its use.

3.5.4 General Safety Practices and Mitigation Measures

Some hazards can be minimized by implementing specific safety procedures, work practices, special equipment, training of personnel, and emergency response equipment in case of an accident. Section 9.4 of Annex III (H&S Plan) of the IWP discusses some of these practices. The following routine measures will be taken:

- Daily planning and/or pre-activity meetings will be held for all personnel involved in field activities. These meetings will discuss health and safety concerns and refresh personnel on the emergency response plans.
- Workers will shower as soon as possible after field work.
- Control zones will be established according to the field activity and level of protection at each area of the OU, and will be specified in the form of maps in site-specific plans prior to the initiation of field work at each area. The plans will include the locations of administrative and medical support. Control zones will be established for safety as well as contamination control and decontamination procedures.
- If troublesome levels of dust are generated during augering or drilling activities, water may be used to suppress dust for the protection of field personnel.
- The buddy system will be employed as a general practice.

3.6 Site-access Control

3.6.1 Restricted-Access and Exclusion Zones

Restricted-access or exclusion zones will be established before work begins at contaminated sites to protect workers from unnecessary exposure to toxic materials and to prevent the spread of contamination. A general description of exclusion zones is found in Section 7.0 of Annex III (H&S Plan) of the IWP.

3.6.2 Decontamination

Personnel, equipment, and vehicles that have been in contaminated areas may carry residual contamination. Although protective clothing, respirators, and good work practices can help reduce contamination, decontamination may be necessary to prevent exposure of personnel and the inadvertent spread of contaminants.

Vehicles and equipment that are suspected of being contaminated will be cleaned with high pressure steam or equally effective systems. Vehicles and equipment suspected of being contaminated with alpha contamination will be screened with alpha survey instruments before being released from the site.

Personnel decontamination can be performed in all levels of protection. Disposable protective equipment need not be decontaminated but should be disposed of as a hazardous waste. Reusable protective equipment must be decontaminated using a soap and water wash and two successive rinses. Visual inspections of the equipment will help determine the effectiveness of the decontamination process. As with the equipment, personnel will be screened with an alpha scintillometer when working with or near alpha contaminated material. ER Program SOPs, established to guide the decontamination process, will be maintained onsite and will be followed at all times. Personnel decontamination procedures are specified in ER SOP 02.08, Personnel Decontamination. Equipment decontamination will follow ER SOP 02.07, General Equipment Decontamination. LANL Administrative Requirements for Waste Management are 10.1, Radioactive Liquid Waste; 10.2, Low-Level Radioactive Solid Waste; 10.3, Chemical, Hazardous and Mixed Waste; and 10.5, Transuranic Solid Waste.

In addition to the following list, Section 10.0 of Annex IIII (H&S Plan) of the IWP contains information on decontamination:

1. The level of decontamination required will depend on the nature and magnitude of contamination and the type of protective clothing worn. Disposable clothing (i.e., TYVEK) will not be washed because water may transport contamination through the paper garment to the skin.
2. Waste water and materials used during decontamination will be contained for appropriate disposal. Arrangements will be made with LANL for acquisition and disposal of drums containing soapy water, rinse water, methanol, and trash.

3.7 Worker Training

Worker training will follow the requirements set forth in Section 11.0 of Annex III (H&S Plan) of the IWP. Field personnel will be given copies of all relevant SOPs and will be briefed on their uses. Field personnel also will read this OU Health and Safety Plan and Annex III (H&S Plan) of the IWP.

3.8 Employee Medical Program

In addition to the guidance provided in Section 12.0 of Annex III (H&S Plan) of the IWP, the following paragraph details specific program requirements.

Field team members who are exposed to contaminated materials during ER remedial investigations shall participate in a medical examination program provided by the Laboratory according to 29 CFR Part 1910 or DOE Order 5480.1B (Chapter VIII) Requirements. Suitability of field team members for conducting field sampling activities, including respirator use, shall be evaluated and documented by a physician. Medical programs must comply with the requirements of DOE Order 5480.1B Chapter VIII or 29 CFR Part 1910, as appropriate. LANL Administrative Requirements 2-1, Occupational Medicine Program, 3-6, Biological Monitoring for Radioactive Materials; 6-4, Biological Monitoring for Hazardous Materials; and LANL Technical Bulletin 606, Biological Sample Monitoring, shall be followed.

3.9 Records and Reporting Requirements

The ER H&S PL, working with the OU PL, Site Safety Officer, and Field Teams Manager, will ensure that health and safety records are maintained within the appropriate LANL group as required by DOE orders. The reports are as follows:

- DOE-AL Order 5000.3A, Unusual Occurrence Reporting
- DOE Form 5484.3, Supplementary Record of Occupational Injuries and Illnesses, Attachment 1.
- DOE Form 5484.4, Tabulation of Property Damage Experience, Attachment 2.
- DOE Form 5485.5, Report of Property Damage or Loss, Attachment 4.
- DOE Form 5484.6, Annual Summary of Whole Body Exposures to Ionizing Radiation, Attachment 13.
- DOE Form 5484.1, Summary of Exposures Resulting in Internal Body Depositions of Radioactive Materials for CY 19____, Attachment 14.
- DOE Form 5484.8, Termination Occupational Exposure Report, Attachment 10.
- DOE Form OSHA-200, Log of Occupational Injuries and Illnesses, Attachment 7.
- DOE Form EV-102A, Summary of Department of Energy and Department of Energy Contractor Occupational Injuries and Illnesses, Attachment 8.
- DOE Form 5821.1, Unplanned Releases Form, Attachment 15.

Copies of these reports will be stored with the appropriate LANL group. Specific reporting responsibilities are given in the following sections and in Chapter 1, General Administrative Requirements of the LANL H&S Manual.

3.9.1 Exposure and Medical Records

Confidential records of the medical status of each field team member, obtained through the employee medical program, will be maintained with the appropriate Laboratory group and, as necessary, coordinated with the ER Program office. The requirements established below must be met in addition to the requirements set forth in Section 13.1 of Annex III (H&S Plan) of the IWP. Field team members will be issued a radiation dosimeter by LANL, according to Administrative Requirement 3-1, Personnel Radiation Exposure Control.

DOE Forms 5484.1, Summary of Exposures Resulting in Internal Body Depositions of Radioactive Materials for CY 19___, and 5484.6, Annual Summary of Whole Body Exposures to Ionizing Radiation, will be submitted annually by March 31 for monitored employees. Preparation of these reports will be coordinated with the HS-1 Radiation Protection Group.

3.9.2 Unusual Occurrence

All unusual occurrences must be reported by the OU Site Safety Officer to the H&S PL, Field Teams Manager, and TA-2 and TA-41 OU PL in accordance with Section 13.2 of Annex III (H&S Plan) of the IWP.

3.9.3 Accident/Incident Reports

The LANL Project Leader will submit a completed DOE Form F 5484.X for any of the following accidents/incidents, according to LANL Administrative Requirement 1-1.

1. Occupational Injury is any injury such as a cut, fracture, sprain, or amputation that results from a work accident or from an exposure involving a single incident in the work environment.

NOTE: Conditions resulting from animal bites, such as insect or snake bites, or from one-time exposure to chemicals are considered injuries.

2. Occupational Illness of an employee is any abnormal condition or disorder, other than one resulting from an occupational injury, caused by exposure to environmental factors associated with employment. It includes acute and chronic illnesses or diseases that may be caused by inhalation, absorption, ingestion, or direct contact with a toxic material.
3. Property Damage Losses of $1,000 or more must be reported. Accidents that cause damage to DOE property, regardless of fault, or accidents wherein DOE may be liable for damage to a second party, are reportable where damage is $1,000 or more. Include damage to facilities, inventories, equipment, and properly parked motor vehicles. Exclude damage resulting from a DOE-reported vehicle accident.
4. Government Motor Vehicle Accidents resulting in damages of $150 or more or involving an injury, unless the government vehicle is not at fault, damage of less than $150 is sustained by the government vehicle and no injury is inflicted on the government vehicle occupants.

Accidents also are 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; and

- any person is injured and the driver of a government vehicle is at fault.

3.10 Employee Information

The site safety officer shall ensure that the following DOE and LANL forms are posted where field team leaders and field team members can easily read them:

- Form F 5480.2, Occupational Safety and Health Protection
- Form F 5480.4, Occupational Safety and Health Complaint Form
- LANL Special Work Permit
- OSHA Job Safety and Health Protection Form

The LANL health and safety standard concerning employees' right-to-know also shall be posted at the work site. Additionally, employees will be required to sign the form in Table III-4 prior to initiation of field work.

Other information which shall be made available to site employees include:

- IWP, TA-2 and TA-41 OU work plan and ancillary documents;
- Pertinent Laboratory H&S documents including administrative policy and SOPs;
- Field monitoring data; and
- Personal monitoring data (e.g., TLD results) and personal medical records for the requesting individual

4.0 Emergency Response and Notification

This section provides information on responding to emergency situations. LANL Administrative Requirement 1-2, Emergency Preparedness, Administrative Requirement 1–8, Working Alone, and Technical Bulletin 101, Emergency Preparedness, were used in developing an emergency response plan.

4.1 Emergency Contacts

The names of persons and services to contact in case of emergencies are given in Attachment III-2. This emergency contact form will be copied and posted in prominent locations at the work site. Two-way radio communication will be maintained at remote sites when possible.

The emergency contact number for the Laboratory is 9-911 (911 also works).

4.2 Contingency Plans

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. Evacuation plans and routes used by INC and WX Divisions are discussed in Section 4.2.3, Emergency Response Plan, of this annex.

4.2.1 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 combustible gas meter indicates gas concentrations at levels of 20% of the lower explosive limit, personnel will be evacuated from that area. 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.

4.2.2 Personnel Injuries

In case of serious injuries, the victim(s) will be transported to a medical facility as soon as possible. The Laboratory Fire Department provides emergency transport services. Minor injuries may be treated by trained personnel in the work area. All injuries should be reported to the 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 (as outlined in Subsection 4.6.2) only if it will not aggravate the injury. Treatment of life-threatening or serious injuries will always be undertaken first.

4.2.3 Emergency Response Plan

A map will be attached to each field copy of the site-specific Health and Safety Plans generated for work at OU 1098. The map will define the routes to the Laboratory's HS-2, Occupational Medicine Group and the Los Alamos County Medical Center.

For general emergencies that require evacuation (i.e., fire, medical, security, releases, etc.) an emergency response plan specific to TA-2 and TA-41 is required. In a worst case, an evacuation of all personnel from TA-2 and TA-41 would be required; in most instances a safe distance onsite may be established to protect personnel.

The signal for site evacuation will be two long blasts on an air horn. The crew will gather at a specified location (normally at the vehicles) and proceed away from the affected area. One person should find the nearest phone at a safe distance and call the fire department at 9-911. The phone and the evacuation route used by field personnel should be in the direction away from the affected area and toward the TA-2 and TA-41 exit within Los Alamos Canyon (this is the only routine exit from TA-2 and TA-41). At the exit, all personnel will wait until every person in the field crew has been accounted for. The OU 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. This will be signaled by two short blasts on an air horn. If the signal is heard, personnel will meet at a predetermined area, which will be determined based on wind conditions. A portable wind sock or streamer will be positioned at each work location and personnel notified of the location. If the horn is sounded, 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 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 OU Site Safety Officer will determine the next course of action.

For a less severe accident, such as a minor release or small fire, site evacuation may not be necessary. This scenario will be signaled by one long blast on an air horn. All personnel will meet at a designated area (e.g., the vehicles) and all personnel will be accounted for by the OU Field Team Leader and/or Site Safety Officer. Further instructions will be given by the Site Safety Officer.

These procedures will be reviewed at least once per week to remind field personnel of the procedures and the signals. Summarized below are the signals for easy reference. This information will be posted at prominent locations at each work location with other H&S information.

- Major fire - two long blasts on the air horn
- Major release - two short blasts on the air horn
- Minor fire or release - one long blast on the air horn

4.2.4 Additional Emergencies

For information on accidental release of hazardous materials into the environment, unusual events, site alerts, site emergencies and general emergencies, see Chapter 7 of Annex III (H&S Plan) of the IWP.

4.3 Notification requirements

In emergency situations, field team members will notify the Site Safety Officer. The Site Safety Officer's responsibility is to notify the appropriate emergency assistance personnel (e.g., fire, police, ambulance), the field teams manager and the LANL HS Division Office according to DOE Order 5500.2 and DOE-AL Order 5500.2B and 5000.3A. The LANL HS Division Office is responsible for implementing notification and reporting requirements according to DOE Order 5484.1A, DOE Order 5484.2, and DOE AL Order 5484.2.

References for Annex III

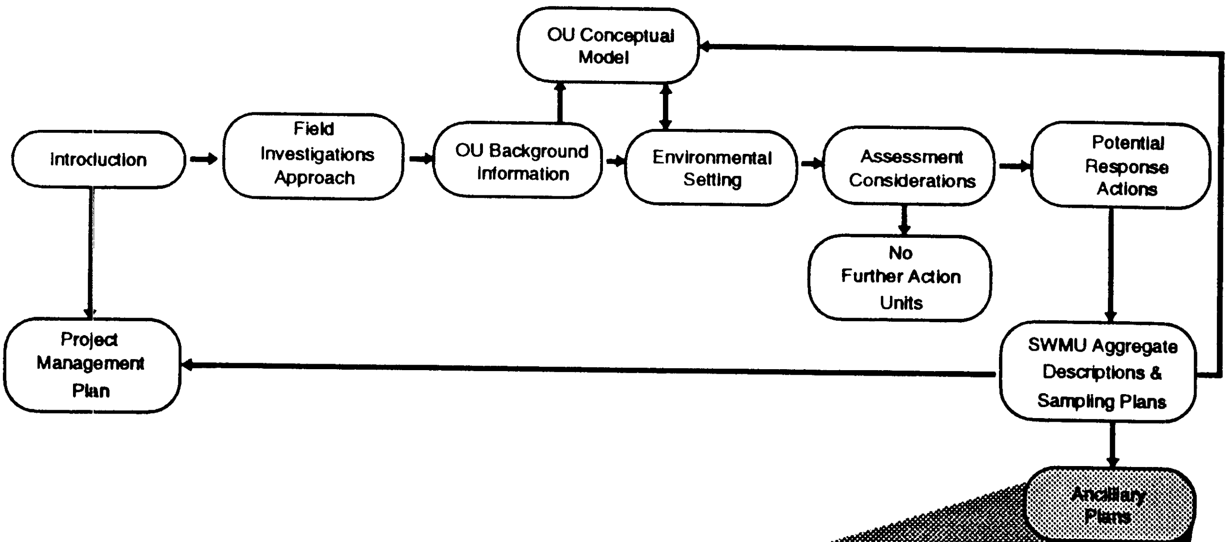
EPA (US Environmental Protection Agency) 1988, Office of Emergency and Remedial Response, Hazardous Response Support Division, Environmental Response Team, Standard Operating Safety Guides (SOS6) (EPA 1988, 0609).

LANL November 1991. "Installation Work Plan for Environmental Restoration", Revision 1, Volume I and II, No. LA-UR-91-3310,Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 1991, 0145)

NIOSH(National Institute for Occupational Safety and Health), OSHA (Occupational Safety and Health Administration), USCG (US Coast Guard), and EOA (Environmental Protection Agency), "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities," October 1985. (NIOSH 1985, 0414)

OSHA (Occupational Safety and Health Administration), July 1, 1991. "Hazardous Waste Operations and Emergency Response," Code of Federal Regulations,(title) Title 29, Part 1910.120, Washington, DC. (OSHA 1991, 0610)

Annex IV



Records Management Project Plan

TABLE OF CONTENTS

ANNEX IV: RECORDS MANAGEMENT PLAN

1.0 Introduction

The Records Management Plan (RMP) for the Environmental Restoration (ER) Program at Los Alamos National Laboratory (the Laboratory) is described in Annex IV of the Installation Work Plan (IWP) (LANL 1991, 0553). The purposes of the RMP are to meet the requirements for protecting and managing records (including technical data), to provide an ongoing tool to support the technical efforts of the ER Program, and to function as a support system for management decisions throughout the existence of the ER Program.

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

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

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

2.0 Implementation of the Records Management Plan

Chapter 2 of the RMP describes the implementation of the records management program. Records management activities for Operable Unit (OU) 1098 will follow the guidelines summarized in that chapter. As the RMP develops to support OU needs, additional detail will be provided in annual updates of the IWP.

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

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

3.0 Use of ER Program Records Management Facilities

The Environmental Restoration Program's RPF and FIMAD facilities will be utilized for management of records resulting from the conduct of work on Operable Unit 1098. Interaction with these facilities is detailed in LANL -ER-AP-2.01, Annex IV of the Installation Work Plan, and other Program procedures and management guidance documents as appropriate.

4.0 Coordination with the Quality Program

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

5.0 Coordination with the Health and Safety Program

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

6.0 Coordination with the ER Program's Management Information System

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

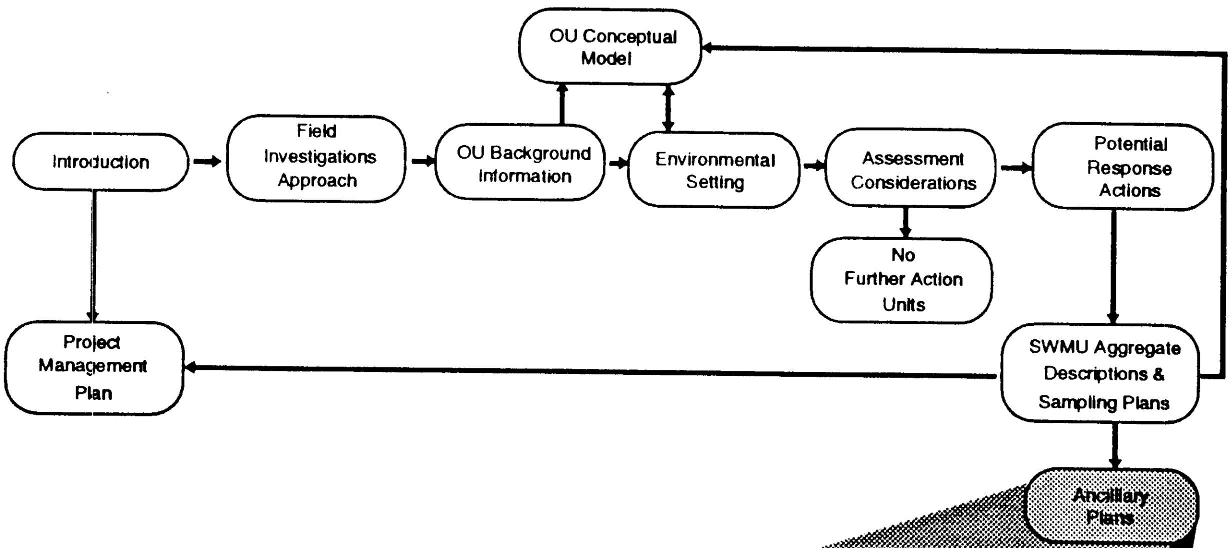
7.0 Coordination with the Community Relations Program

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

Annex IV Reference

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

Annex V



Community Relations Project Plan

TABLE OF CONTENTS

Annex V Figures

Annex V Attachments

ANNEX V: COMMUNITY RELATIONS PLAN FOR OPERABLE UNIT 1098 (TECHNICAL AREAS-2 AND 41)

1.0 Overview of Community Relations Plan

The Community Relations Plan specific to Operable Unit (OU) 1098 (Technical Areas-2 and TA-41) follows the directives, goals, and regulatory requirements set forth in the Community Relations Program Plan in Annex V, Volume 1 of the Installation Work Plan (IWP) (LANL 1991, 0553) for Environmental Restoration (ER). This annex details the community relations activities for OU during the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI). The activities are based on current knowledge of public information needs and resources available to the Los Alamos National Laboratory (Laboratory) ER Program Staff.

As shown in Figure V-1, public participation is required by regulation during the corrective measures study (CMS); therefore, the Laboratory will provide opportunities for public participation during the five-year RFI process as detailed in the annex and illustrated in Figure V-2. The Hazardous and Solid Waste Amendments (HSWA) module of the Laboratory's RCRA Facility Permit requires that the following specific items be addressed in the Community Relations Plan:

- Establishing a mailing list of interested parties;
- News releases, fact sheets, approved RFI Workplans, RFI final reports, Special Permit conditions Reports and publicly available quarterly progress reports that explain the progress and conclusions of the RFI;
- Creation of public information repository and reading room with updates of available material;
- Informal meetings between the public and local officials, including briefings and workshops as appropriate;
- Public tours and briefings to address individual concerns and questions;
- Quarterly technical progress reports during the RFI process for the Administrative Authority; and
- Procedures for immediate notification of the San Idelfonso Pueblo or other neighboring affected parties in the event of a newly-discovered off-site release which could potentially affect them.

These items are addressed in Sections 2.1 through 2.6 of this plan.

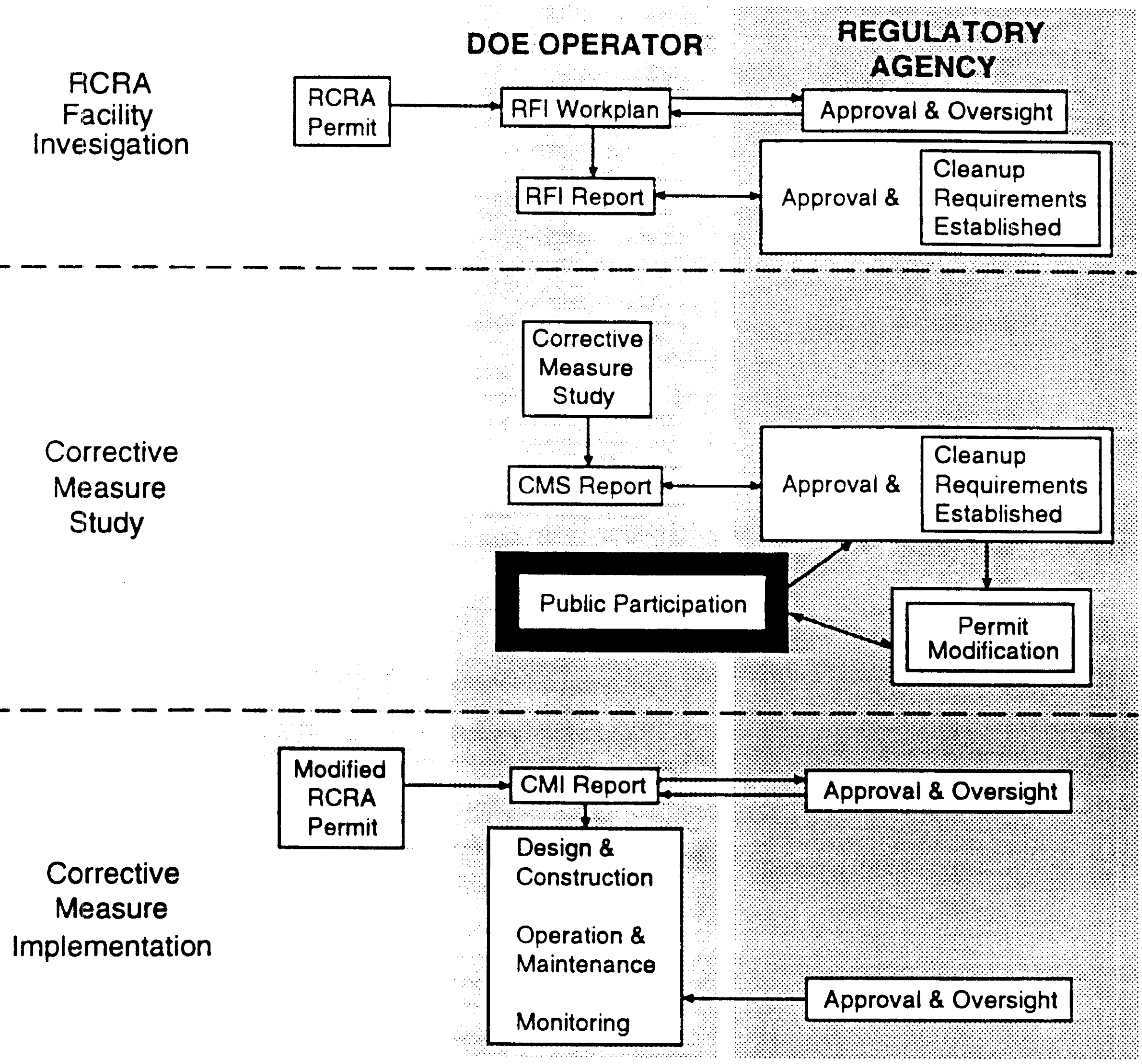


Figure V-1 Regulatory mandated opportunities for public participation during the RCRA corrective action process

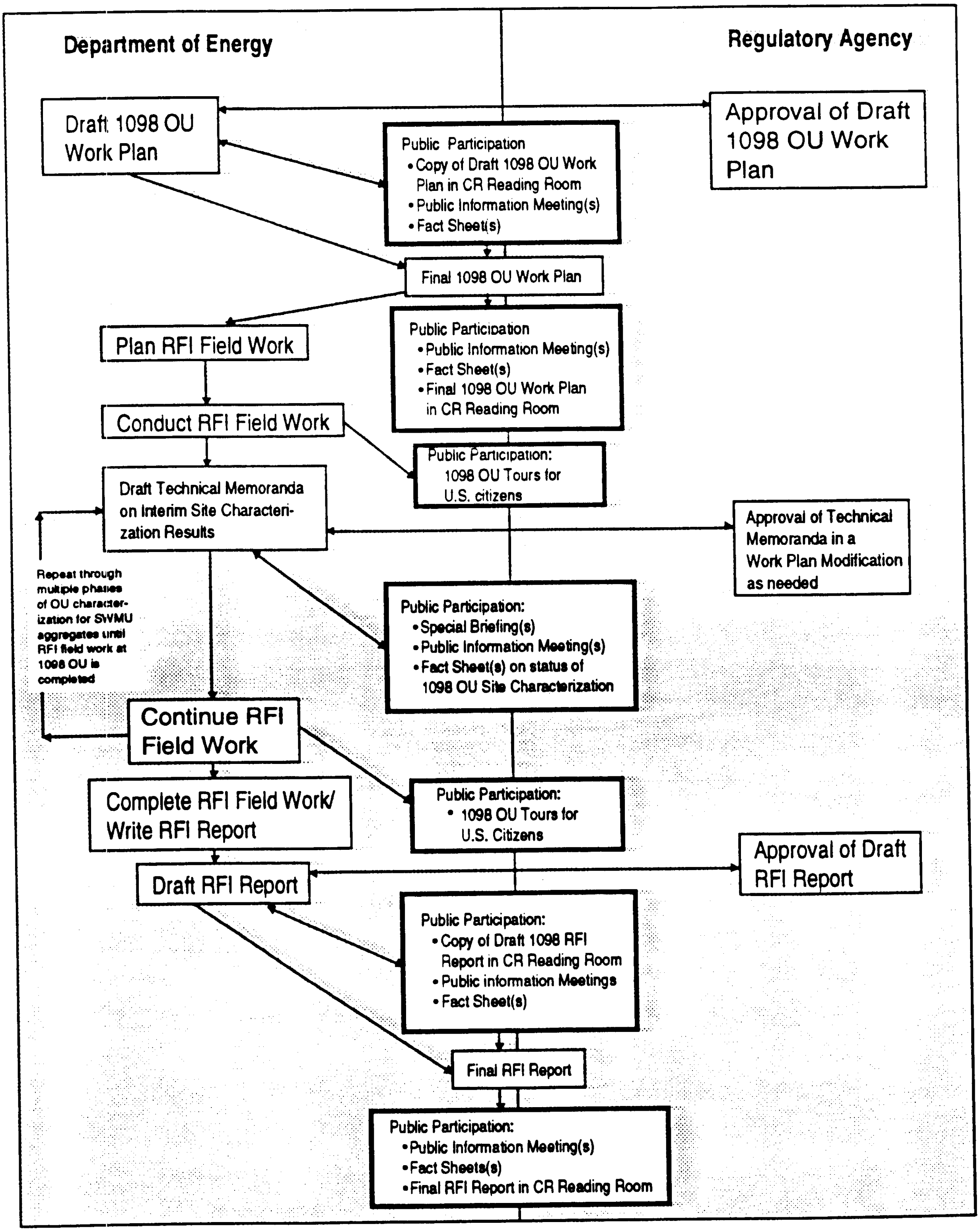


Figure V-2. Opportunities for public participation during the 1098 OU RFI

All information concerning ER program activities at OU 1098 will originate with or be provided to the public through the community relations project leader as follows:

Community Relations Project Leader
Environmental Restoration Program
Los Alamos National Laboratory
2101 Trinity Drive, Suite 20
Los Alamos, New Mexico 87544
(505) 665-2127

2.0 Community Relations Activities

The following is a brief description of community relations activities to be conducted during RFI activities at the TA-2 and TA-41 OU. These activities are designed to address key concerns identified by the TA-2 and TA-41 OU team and IWP. The scope of each activity is flexible and can be tailored to respond to public information needs.

2.1 Mailing List

Community Relations will enhance the ER Program mailing list to include former workers at TA-2 and TA-41 to keep them informed of meetings, activities, and schedules pertaining to the TA-2 and TA-41 OU. Furthermore, an informal dialogue will be maintained with the management at Bandelier National Monument to complement the mailings and provide a faster means of response.

2.2 Fact Sheets

The Community Relations Office developed a fact sheet that shows the TA-2 and TA-41 OU and the location of its SWMUs, and that summarizes site history and use, known contaminant's of concern, and planned activities (see Attachment 1 to this Annex). The initial fact sheet was distributed in June 1991 and revised in May 1992. Updated fact sheets will be developed as public information needs change and progress is made. A map showing SWMU locations at TA-2 and TA-41 will be available for public review in the ER Program's Public Reading Room.

2.3 ER Community Reading Room

As they are developed, documents and data associated with the TA-2 and TA-41 OU, such as the RFI Work Plan, quarterly technical progress reports, the RFI report, and other reports, will be available to the public at the ER Community Reading Room at TriSquare, 2101 Trinity Drive, Suite 20, in downtown Los Alamos, from 9 a.m. to 4.p.m. on Laboratory business days. A copy of the TA-2 and Ta-41 OU RFI Draft Work Plan will be available at the reading room in May 1993.

2.4 Public Information Meetings, Briefings, Tours and Responses to, Inquiries

Once initial information has been gathered and a specific mailing list developed, there will be public information meetings held in Los Alamos to introduce the public to forthcoming activities described in the work plan for the TA-2 and TA-41 OU. The TA-2 and TA-41 OU Project Leader, with the assistance of the Community Relations Project Leader, will present information and respond to questions and concerns raised by the public. The Laboratory and Department of Energy plan to hold quarterly public information meetings to discuss specific activities and significant milestones during the RFI. Tours will be conducted for interested parties upon request.

If a limited interest issue of concern is raised at a public information meeting, it may be necessary to hold a special briefing or to respond on a one-to-one basis to the inquiry. These inquiries will be coordinated by the Community Relations Project Leader and the TA-2 and TA-41 OU Project Leader.

2.5 Quarterly Technical Progress Reports

As the TA-2 and TA-41 OU RFI is implemented, the Laboratory will summarize technical progress in quarterly technical progress reports, as required by the HSWA module of the Laboratory's RCRA Facility Permit (Task V, C, page 46). These reports will be available at the ER Community Reading Room.

2.6 Informal Public Review and Comment on the draft OU 1098 RFI Work Plan

The Laboratory will encourage public input regarding the field sampling proposed in the draft TA-2 and TA-41 OU RFI Work Plan after U.S. Environmental Protection Agency (EPA) formal approval of this document following its submittal to EPA in May 1993. Public input regarding numbers of samples, types of samples, and quality assurance samples (e.g., duplicate samples) will be incorporated, as appropriate, into the final Work Plan.

References for Annex V

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

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

Los Alamos
NATIONAL LABORATORY
ENVIRONMENTAL RESTORATION PROGRAM

LOS ALAMOS NATIONAL LABORATORY ER PROGRAM FACT SHEET FOR OPERABLE UNIT 1098 (TA-2/TA-41)

The RCRA Facility Investigation work plan is a document that addresses the site characterization activities for all SWMUs at OU 1098. This document is being submitted to the EPA in May 1993. Characterization activities are scheduled to begin in October 1993 and continue through 1996.

The primary purpose of this work plan is to describe the site characterization activities and verification sampling that will address potential contaminant releases from the SWMUs comprising OU 1098, thus satisfying the regulatory requirements of Hazardous and Solid Waste Amendments Module VIII of the Los Alamos National Laboratory's RCRA Part B Operating Permit.

Acronyms

CMS - *Corrective Measures Study*

D&D - *Decontamination and Decommissioning*

DOE - *U.S. Department of Energy*

EPA - *U.S. Environmental Protection Agency*

HSWA - *Hazardous and Solid Waste Amendments*

OU - *Operable Unit*

OWR - *Omega West Reactor*

PCB - *Polychlorinated Biphenyls*

RCRA - *Resource Conservation and Recovery Act*

RFI - *RCRA Facility Investigation*

SWMUs - *Solid Waste Management Units*

TA - *Technical Area*

Summary

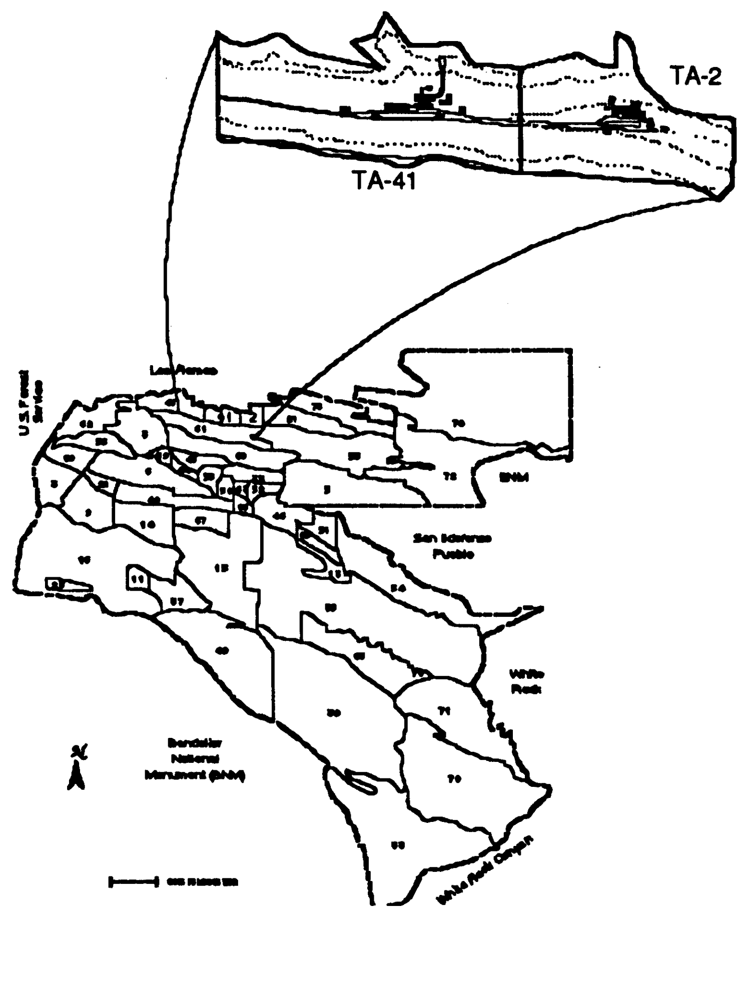
The primary operations at TA-2 involve reactor research with the OWR, an 8-megawatt, water-cooled nuclear reactor fueled by highly enriched uranium. The OWR serves as a research tool by providing a source of neutrons for fundamental studies in nuclear physics and associated fields.

Primary TA-41 operations include tritium, developing weapon boosting systems and conducting long-term studies on weapon subsystems.

Wastes at TA-2 include uranium, chromium, acids, fission products, transuranic elements, and organics, including PCBs and solvents.

Materials used or stored at TA-41 include uranium, plutonium, tritium, lithium, mercury, beryllium, lead, cadmium, class C explosives or electroexplosive devices, toxic gases, organic chemicals, and thermite-type heat generators.

Current Laboratory environmental monitoring has detected contaminants (primarily tritium, cesium-137, and strontium-90) in alluvial groundwater downgradient of TA-2 and TA-41. The depth to the main aquifer in the Santa Fe Group sediments is 800 ft. Geologic media between the land surface and the water table of the main aquifer consist of saturated alluvium, the Otowi Member of the Bandelier Tuff, basalt, and coarse-grained sediments.



PURPOSE OF THE TECHNICAL AREAS:

TA-2 and TA-41 are located at the north central boundary of the Los Alamos National Laboratory, in Los Alamos Canyon (see map on reverse side). Since its establishment in 1944, TA-2 has historically been the site of different nuclear research reactors. Several types of reactors were operated on-site:

1) The "Water Boiler" series of nuclear reactors. The first reactor was constructed in 1944 and fueled by aqueous uranyl solutions. These reactors underwent a number of system modifications until decommissioning in 1987.

2) A self-contained, plutonium-fueled, mercury-cooled reactor called Clementine. This reactor operated from 1946 to 1952, and no known SWMUs are associated with its operation.

3) The present OWR, a water-cooled research nuclear reactor fueled by highly enriched uranium. The OWR is located in the main building (TA-2-1).

TA-41 is used in developing weapon subsystems and conducting long-term studies on weapon subsystems. There are also offices and shop facilities at TA-41.

WASTES PRESENT AT OU 1098

OU 1098 is comprised of thirteen SWMUs identified at TA-2 and four SWMUs identified at TA-41. SWMUs at TA-2 consist of an underground diesel fuel tank, decommissioned reactor waste units, storage pits and tanks, cooling tower drift loss, waste lines, drains, a decommissioned septic system, outfalls, operational releases, and chemical shack waste units. Primary wastes at TA-2 consist of tritium, uranium, chromium, acids, fission products, transuranic elements, and organics, including PCBs and solvents.

Releases of tritium resulted from a leak in the primary cooling water system at OWR. The leak occurred from a break in a weld seam in a section of the delay line running from building TA-2-1 to the surge tank. This release was discovered in January 1993 and was within the Guaje Mountain fault zone. Tritium was leaking from the delay line at a rate of up to 70 gallons per day until March 1993 when the cooling water was drained from this line. Typical concentrations of tritium in the cooling water ranged from 15.7×10^6 to 20.2×10^6 pCi/L

SWMUs at TA-41 include a septic system, sewage treatment plant, sump, and container storage area. Materials used or stored on-site include uranium, plutonium, tritium, lithium, mercury, beryllium, lead, cadmium, explosives, toxic gases, organic chemicals, and thermite-type heat generators.

PREVIOUS CLEANUP AT TA-2 AND TA-41:

In 1985 and 1986, decommissioning of several structures associated with the operations of TA-2 was undertaken. While removing the structures, areas of above background activities of radioactivity were detected. In 1985, PCB levels in contaminated asphalt at TA-2 were reduced to 1 part per million (ppm). Contaminated soil associated with previous reactors was removed and taken to the radioactive disposal area at TA-54; however, areas of residual contamination still remain in several locations at TA-2. No known soil/sediment cleanup activities have taken place at TA-41.

FUTURE ACTION AND PROPOSED TIME FRAME

Future action is focused on further assessment of the extent of contamination and the selection of possible remedial actions. The alternatives range from long-term monitoring and institutional controls to excavation and disposal of contaminated soils and restoration. This process is guided by the HSWA module of the Laboratory's RCRA operating permit, which specifies the sequence of events by which contaminated areas are identified, characterized, and remediated.

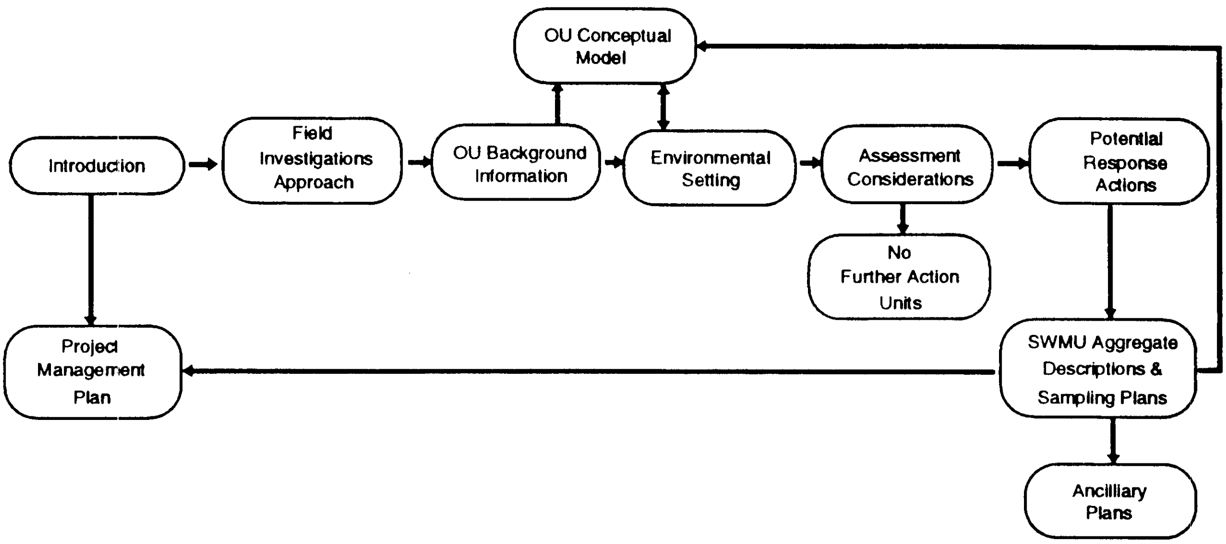
The RFI Work Plan that describes the characterization activities will be completed by May 1993. Actual RFI characterization activities are scheduled to be initiated by October 1993.

CONCLUSION

Ensuring the safe management of past, present, and future waste requires the cooperation of government, industry, and the public. The Laboratory is committed to provide the public with information such as this fact sheet. The Laboratory will continue to provide information concerning actions taken during investigation and throughout the entire cleanup process. If you have additional questions about TA-2 and TA-41 or the Laboratory's Environmental Restoration Program, please do not hesitate to call or write:

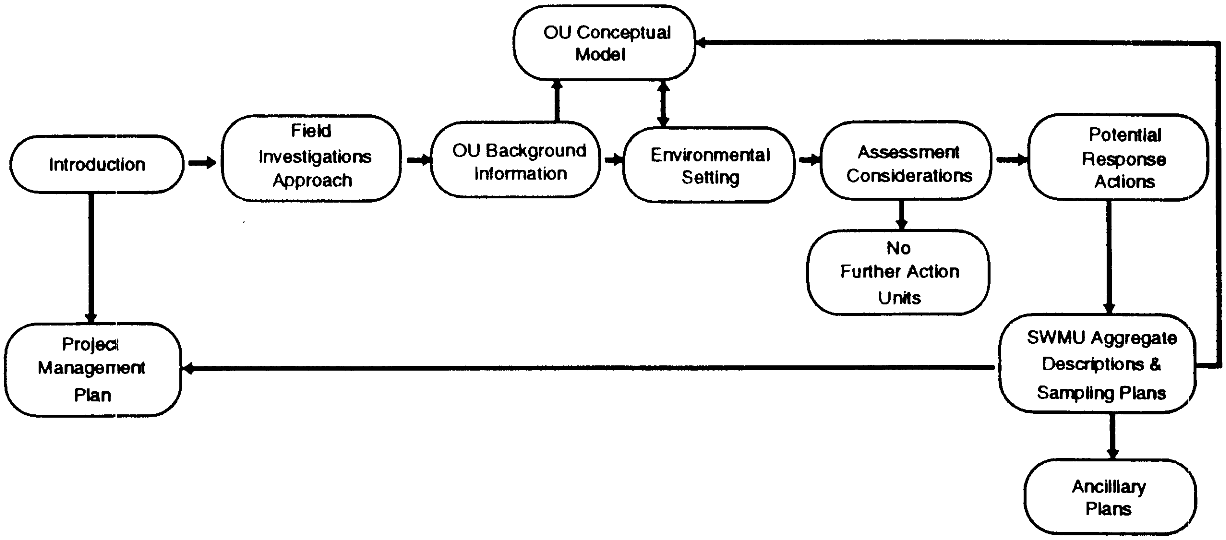
Environmental Restoration Program
Los Alamos National Laboratory
Box 1163, MS M314
Los Alamos, NM 87545
505-665-2127

APPENDIX A

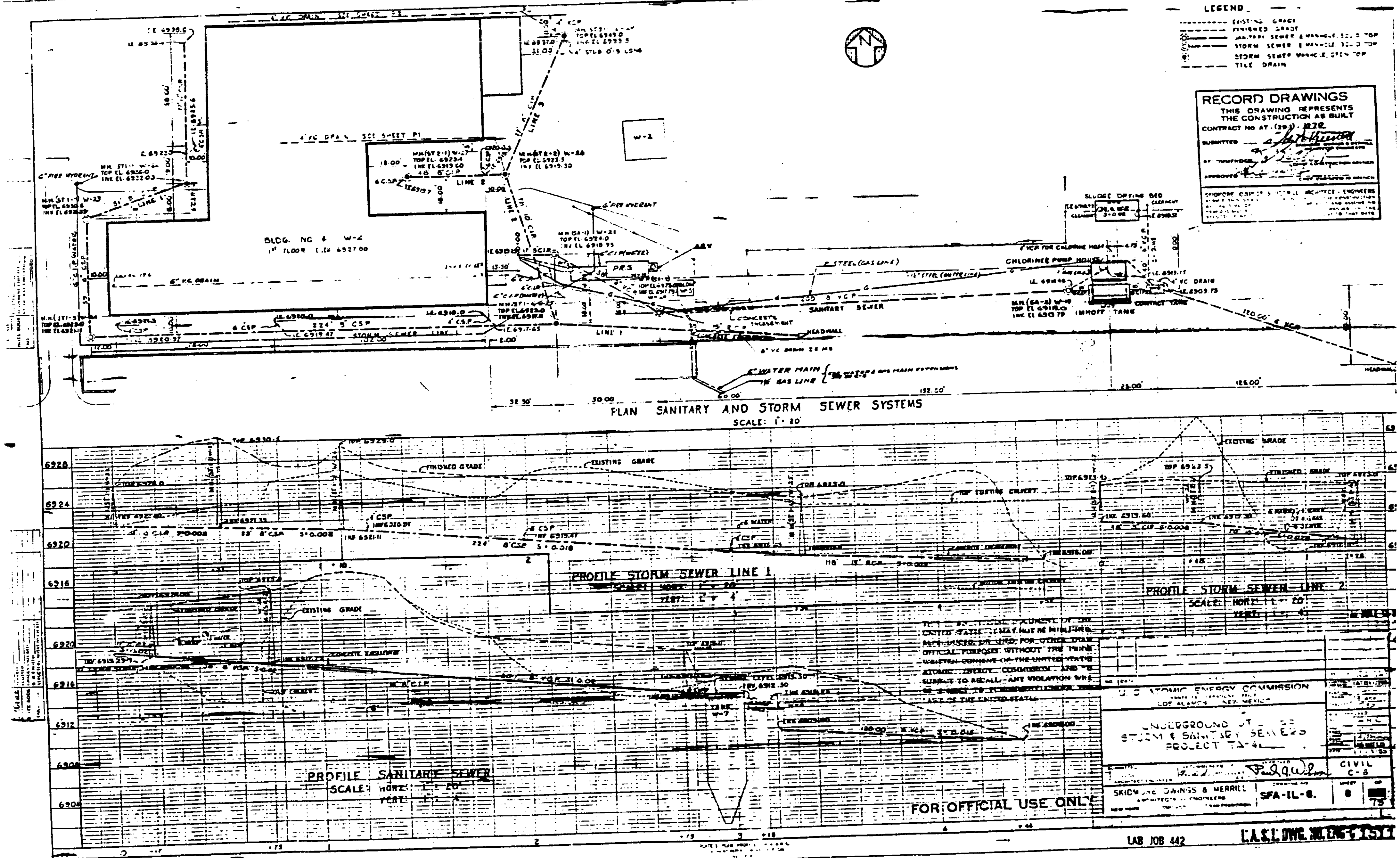


Topographic Map of OU 1098

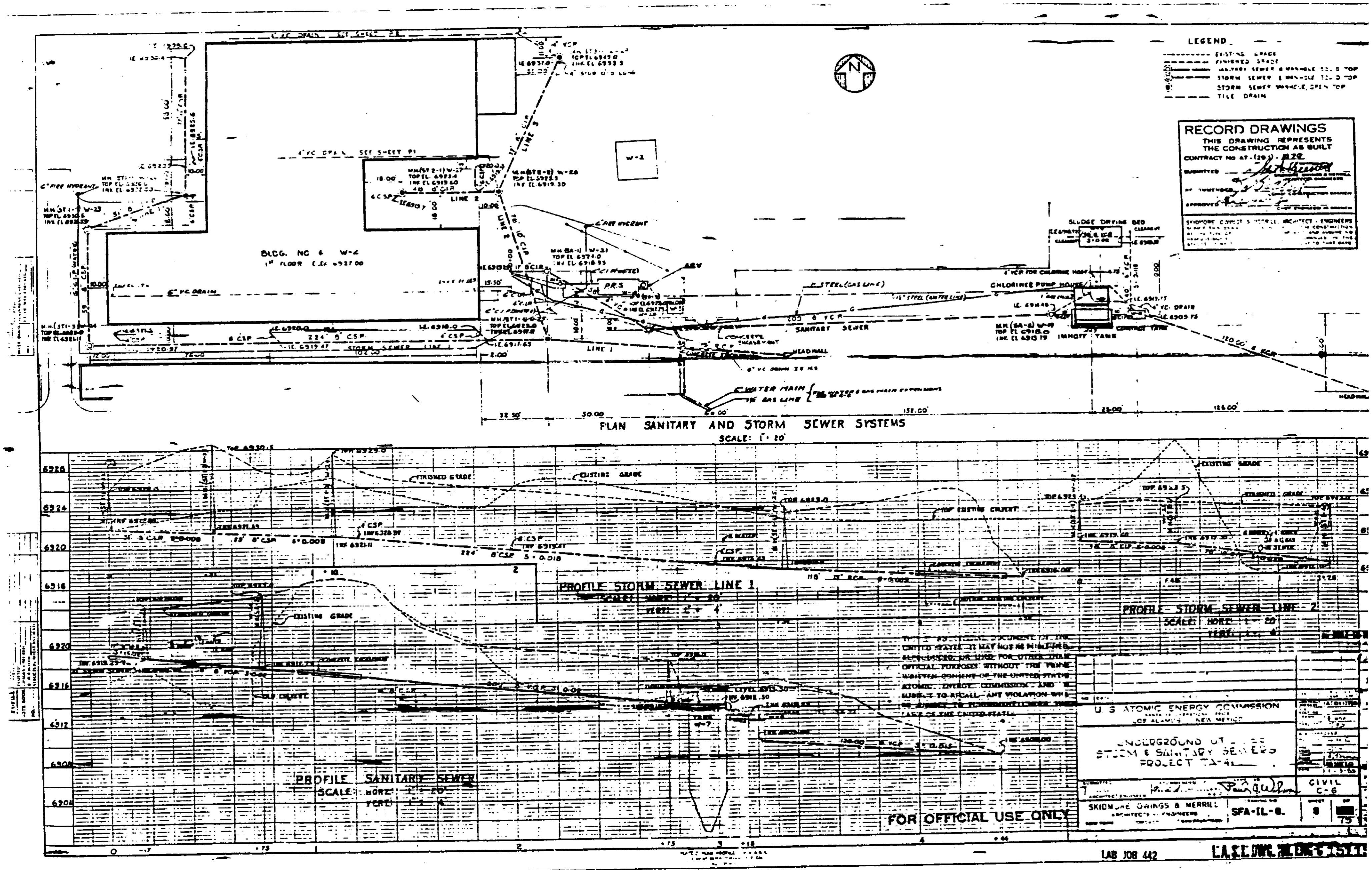
APPENDIX B

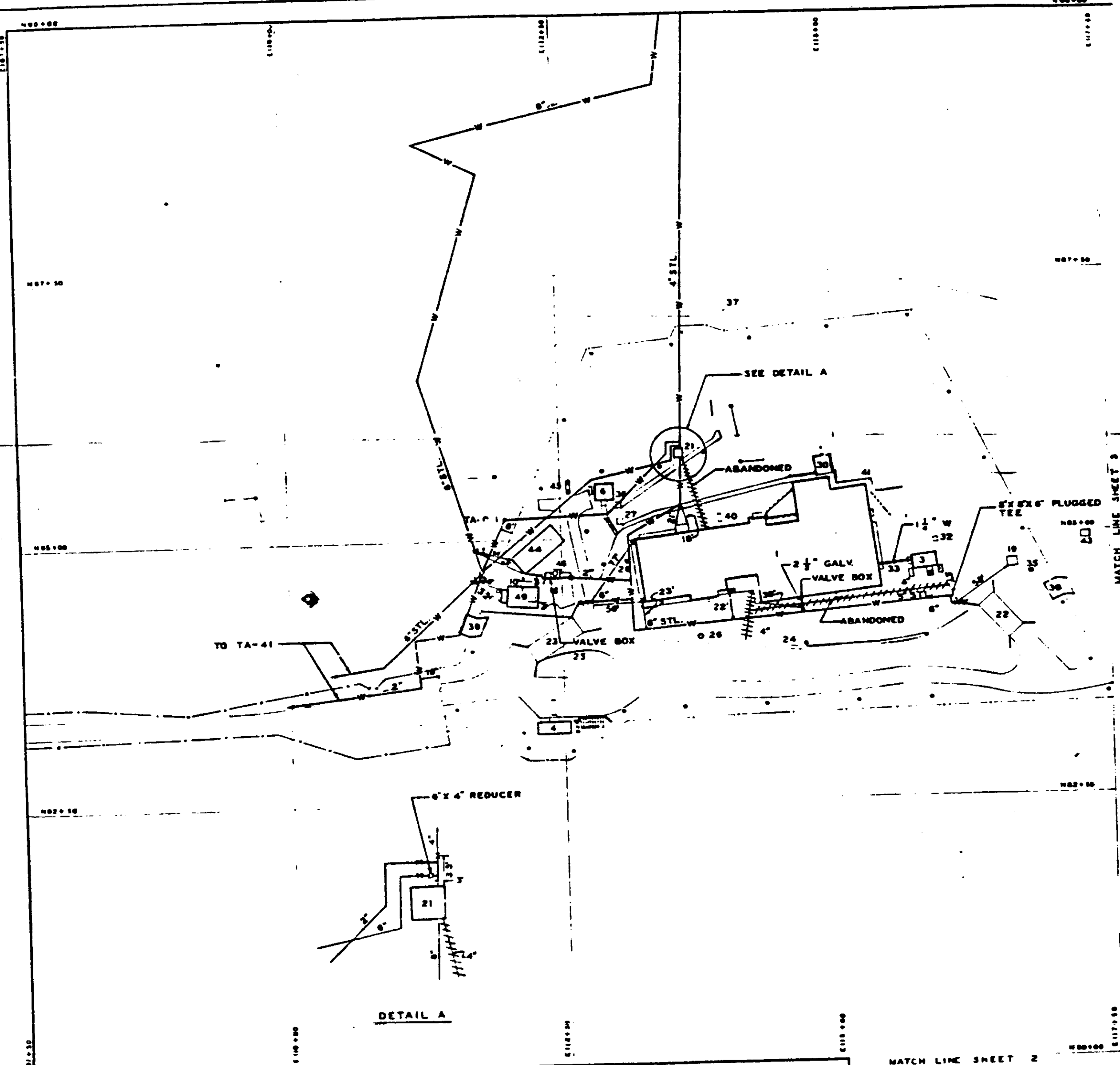


TA-2 and TA-41 Engineering Drawings



LEGEND
EXISTING GRADE
FINISHED GRADE
TILE DRAIN
RECORD DRAWINGS
THIS DRAWING REPRESENTS THE CONSTRUCTION AS BUILT
SUBMITTED
APPROVED
BLDG. NO 4 W-4
1ST FLOOR EL 6927.00
W-2
SLUDGE DRYING BED
CHLORINE PUMP HOUSE
IMHOFF TANK
CONTACT TANK
SANITARY SEWER
HEADWALL
6" WATER MAIN
GAS LINE
LINE 1
LINE 2
LINE 3
PLAN SANITARY AND STORM SEWER SYSTEMS
SCALE: 1" = 20'
EXISTING GRADE
FINISHED GRADE
PROFILE STORM SEWER LINE 1
PROFILE STORM SEWER LINE 2
PROFILE SANITARY SEWER
U. S. ATOMIC ENERGY COMMISSION
LOS ALAMOS, NEW MEXICO
UNDERGROUND UTILITIES
STORM & SANITARY SEWERS
PROJECT TA-41
SKIDMORE, OWINGS & MERRILL
SFA-IL-6.
CIVIL
FOR OFFICIAL USE ONLY
LAB JOB 442


LEGEND
RECORD DRAWINGS
THIS DRAWING REPRESENTS THE CONSTRUCTION AS BUILT
BLDG. NO 6 W-4
1st FLOOR
SLUDGE DRYING BED
CHLORINE PUMP HOUSE
IMHOFF TANK
CONTACT TANK
SANITARY SEWER
STORM SEWER LINE 1
LINE 2
LINE 3
PLAN SANITARY AND STORM SEWER SYSTEMS
SCALE: 1" = 20'
EXISTING GRADE
FINISHED GRADE
PROFILE STORM SEWER LINE 1
PROFILE STORM SEWER LINE 2
PROFILE SANITARY SEWER
U S ATOMIC ENERGY COMMISSION
LOS ALAMOS NEW MEXICO
UNDERGROUND UTILITIES
STORM & SANITARY SEWERS
PROJECT TA-41
SKIDMORE OWINGS & MERRILL
ARCHITECTS - ENGINEERS
CIVIL
C-6
SFA-IL-6
FOR OFFICIAL USE ONLY
LAB JOB 442



LEGEND
- W — WATER LINE
- GATE VALVE
- FIRE HYDRANT
- ABANDONED

REFERENCE DRAWINGS
ENG-C700-C703
ENG-C10787
ENG-C14930-C14931

NO.	DATE	REVISIONS	BY
2	9-23-58	REDRAWN & REVISED TO STATUS OF 7-9-58. SHEET NO. 3 ADDED AND DRAWING NO. CHANGED (WAS ENG-R 300)	

AUTHORIZED FOR: HEALTH / SAFETY / FIRE PROT. / SEC.

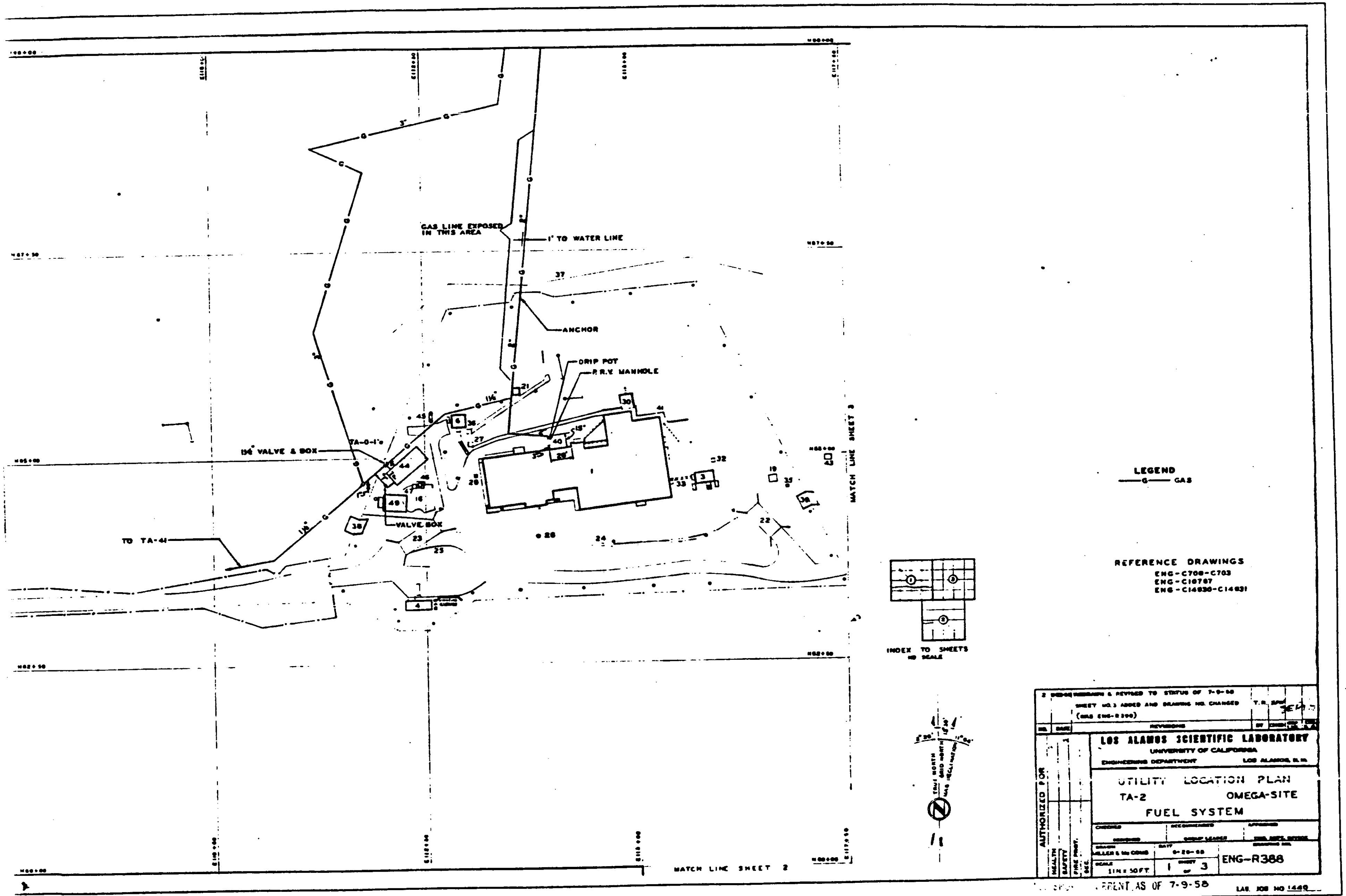
LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
ENGINEERING DEPARTMENT — LOS ALAMOS, N. M.

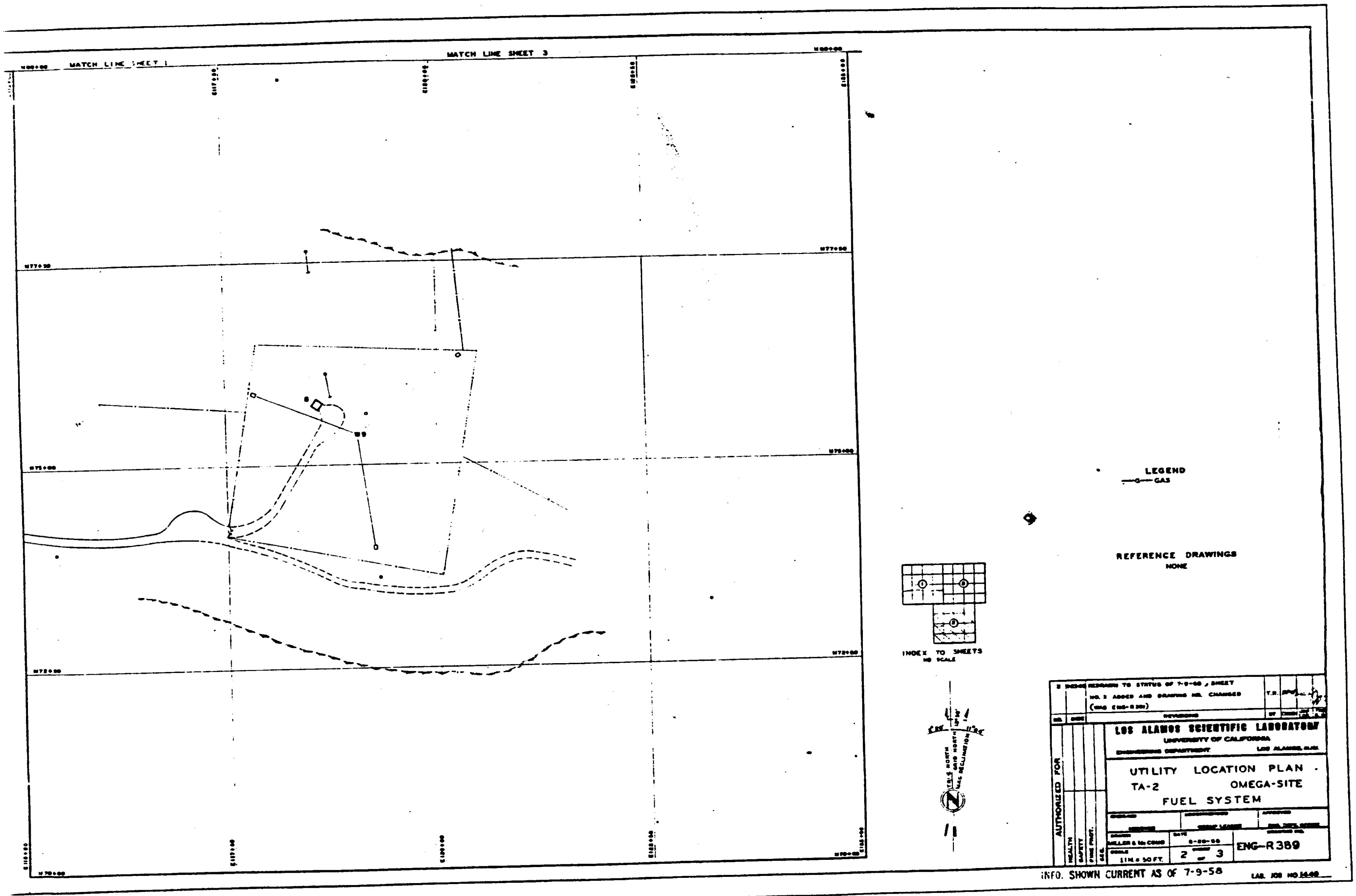
UTILITY LOCATION PLAN
TA-2 OMEGA-SITE
WATER SYSTEM

DRAWN: MILLER & McCOMB
DATE: 9-23-58
SCALE: 1 IN = 50 FT.
SHEET 1 OF 3
ENG-R385

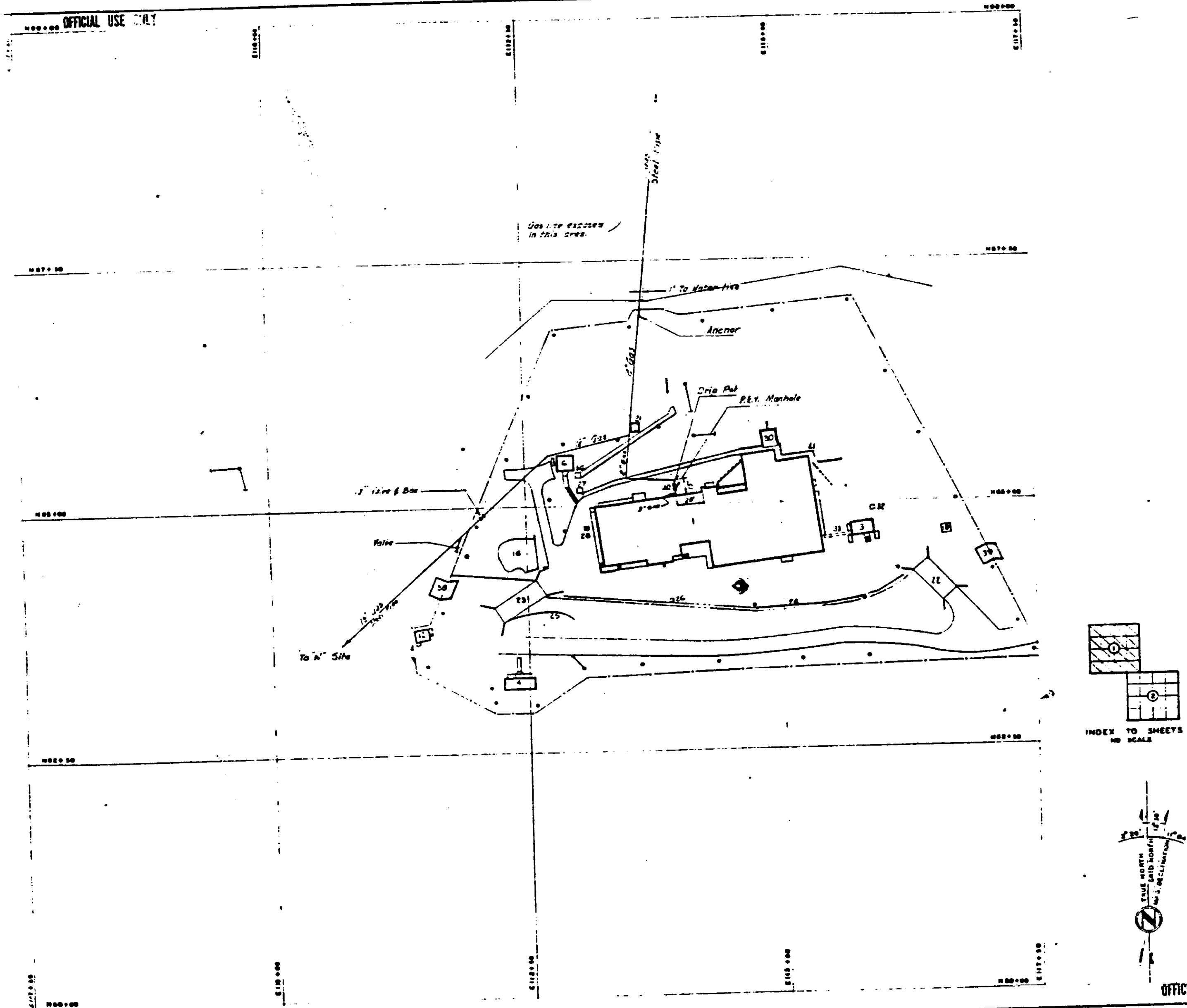
INFO. SHOWN CURRENT AS OF 7-9-58

LAB. JOB NO. 1640


GAS LINE EXPOSED IN THIS AREA
1" TO WATER LINE
ANCHOR
DRIP POT
P.R.V. MANHOLE
1½" VALVE & BOX
TA-0-1"ø
VALVE BOX
TO TA-41
MATCH LINE SHEET 3
MATCH LINE SHEET 2
LEGEND
G GAS
REFERENCE DRAWINGS
ENG-C700-C703
ENG-C10787
ENG-C14830-C14831
INDEX TO SHEETS
NO SCALE
LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
UTILITY LOCATION PLAN
TA-2 OMEGA-SITE
FUEL SYSTEM
AUTHORIZED FOR
HEALTH
SAFETY
FIRE PROT.
ENG-R388
1 OF 3
CURRENT AS OF 7-9-58
LAB. JOB NO 1449


MATCH LINE SHEET 1
MATCH LINE SHEET 3
LEGEND
GAS
REFERENCE DRAWINGS
NONE
INDEX TO SHEETS
NO SCALE
LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
ENGINEERING DEPARTMENT
LOS ALAMOS, N.M.
UTILITY LOCATION PLAN
TA-2
OMEGA-SITE
FUEL SYSTEM
AUTHORIZED FOR
HEALTH
SAFETY
FIRE PROT.
S&G.
1 IN.= 50 FT.
2 of 3
ENG-R389
INFO. SHOWN CURRENT AS OF 7-9-58

OFFICIAL USE ONLY



LEGEND
Gas Line

OFFICIAL USE ONLY

OBSOLETE D'D STORAGE

1	9-26-56	Revised To Field Check Status	
NO.	DATE	REVISIONS	BY CHKD

AUTHORIZED FOR: HEALTH, SAFETY, FIRE PROT., SEC

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
ENGINEERING DEPARTMENT — LOS ALAMOS, N. M.

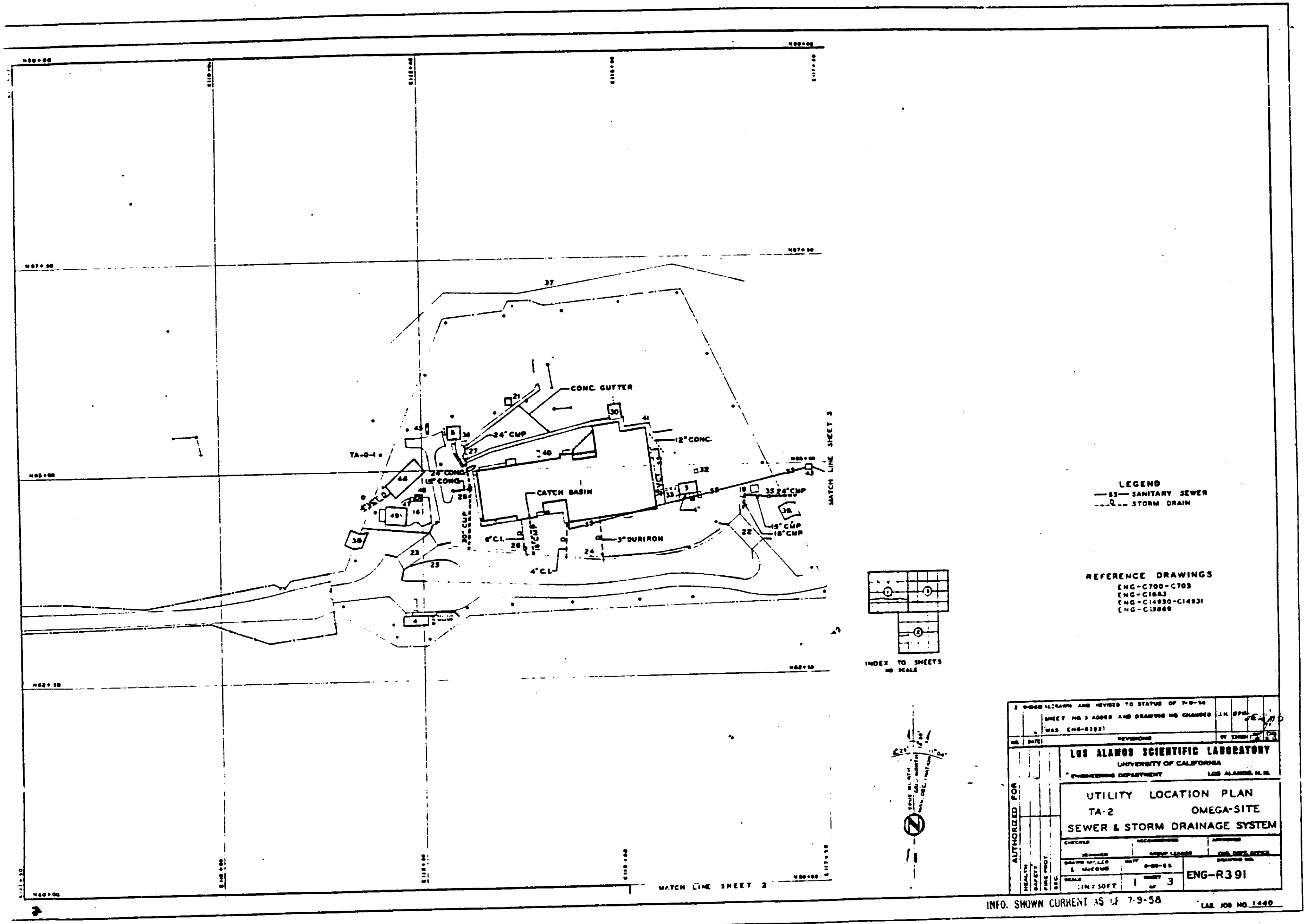
UTILITY LOCATION PLAN
TA-2 OMEGA-SITE
FUEL SYSTEM

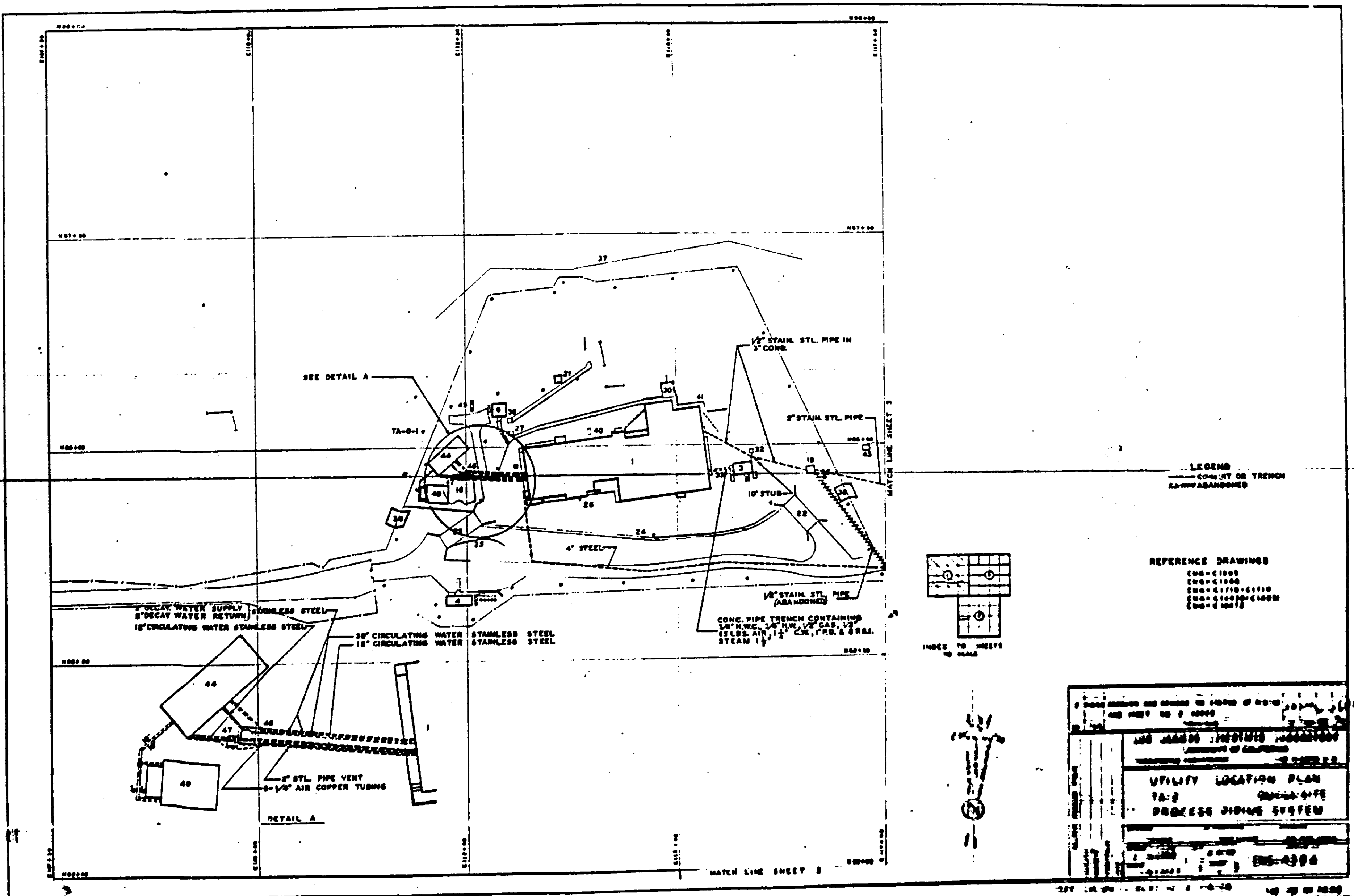
DRAWN: McCOMB — DATE: 9-26-55 — SCALE: 1 IN = 50 FT. — SHEET 1 OF 2 — ENG- R 390

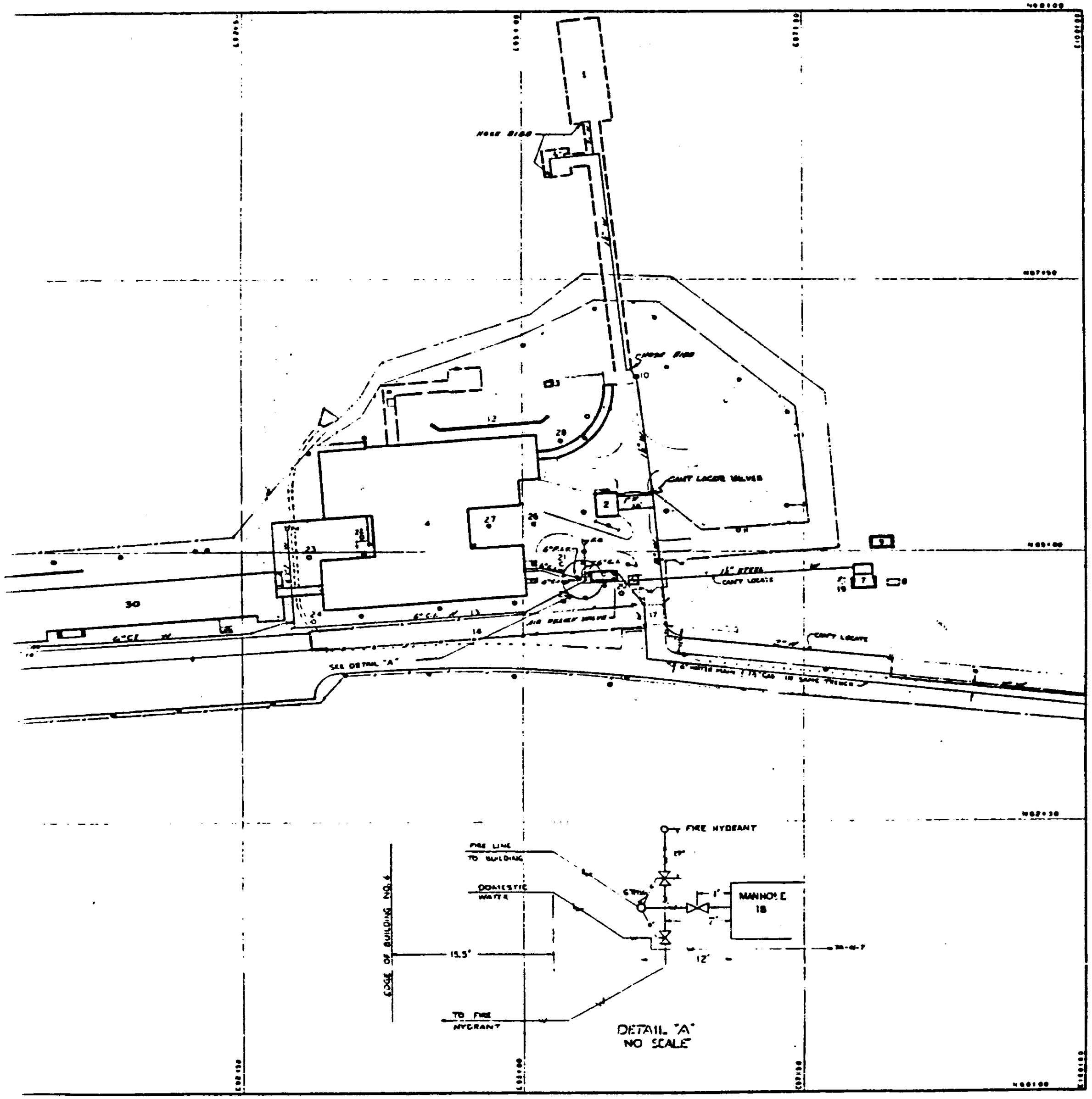
OFFICIAL USE ONLY

LAB. JOB NO.

VOID - REDRAWN AS ENG-R388, REV. #2, DATED 9-23-58


LEGEND
—SS— SANITARY SEWER
--D-- STORM DRAIN
REFERENCE DRAWINGS
ENG-C700-C703
ENG-C1883
ENG-C14930-C14931
ENG-C13869
INDEX TO SHEETS
NO SCALE
MATCH LINE SHEET 3
MATCH LINE SHEET 2
CONC. GUTTER
24" CMP
12" CONC.
CATCH BASIN
3" DURIRON
24" CONC.
18" CONC.
30" CMP
6" C.I.
4" C.I.
15" CMP
18" CMP
24" CMP
TA-0-1
WAS ENG-R3921
REVISIONS
LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
ENGINEERING DEPARTMENT
LOS ALAMOS, N. M.
AUTHORIZED FOR
HEALTH
SAFETY
FIRE PROT.
SEC.
UTILITY LOCATION PLAN
TA-2
OMEGA-SITE
SEWER & STORM DRAINAGE SYSTEM
CHECKED
DESIGNER
RECOMMENDED
GROUP LEADER
APPROVED
ENG. DEPT. OFFICE
SCALE
1 IN = 50 FT.
SHEET 1 OF 3
ENG-R391
INFO. SHOWN CURRENT AS OF 7-9-58
LAB. JOB NO. 1449


UTILITY LOCATION PLAN
TA-2
PROCESS PIPING SYSTEM
LEGEND
CONDUIT OR TRENCH
ABANDONED
REFERENCE DRAWINGS
INDEX TO SHEETS
NO SCALE
MATCH LINE SHEET 3
MATCH LINE SHEET 2
SEE DETAIL A
DETAIL A
1/2" STAIN. STL. PIPE IN 3" COND.
2" STAIN. STL. PIPE
10" STUB
4" STEEL
1/2" STAIN. STL. PIPE (ABANDONED)
CONC. PIPE TRENCH CONTAINING
2" DECAY WATER SUPPLY STAINLESS STEEL
2" DECAY WATER RETURN
12" CIRCULATING WATER STAINLESS STEEL
30" CIRCULATING WATER STAINLESS STEEL
12" CIRCULATING WATER STAINLESS STEEL
2" STL. PIPE VENT
AIR COPPER TUBING
TA-0-1



[redacted]

OFFICIAL USE ONLY

LES REDMAN 4-21-61

4-24-61

LEGEND

- WATER LINE
- GATE VALVE
- POST INDICATOR VALVE
- FIRE HYDRANT

REF. DWGS.

NO	DATE	REVISIONS	BY	CHKD
2		BLDG. 30 & ANNEX		
1	11-2-59	REVISED TO FIELD CHECK STATUS		

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UNIVERSITY OF CALIFORNIA
ENGINEERING DEPARTMENT — LOS ALAMOS, N. M.

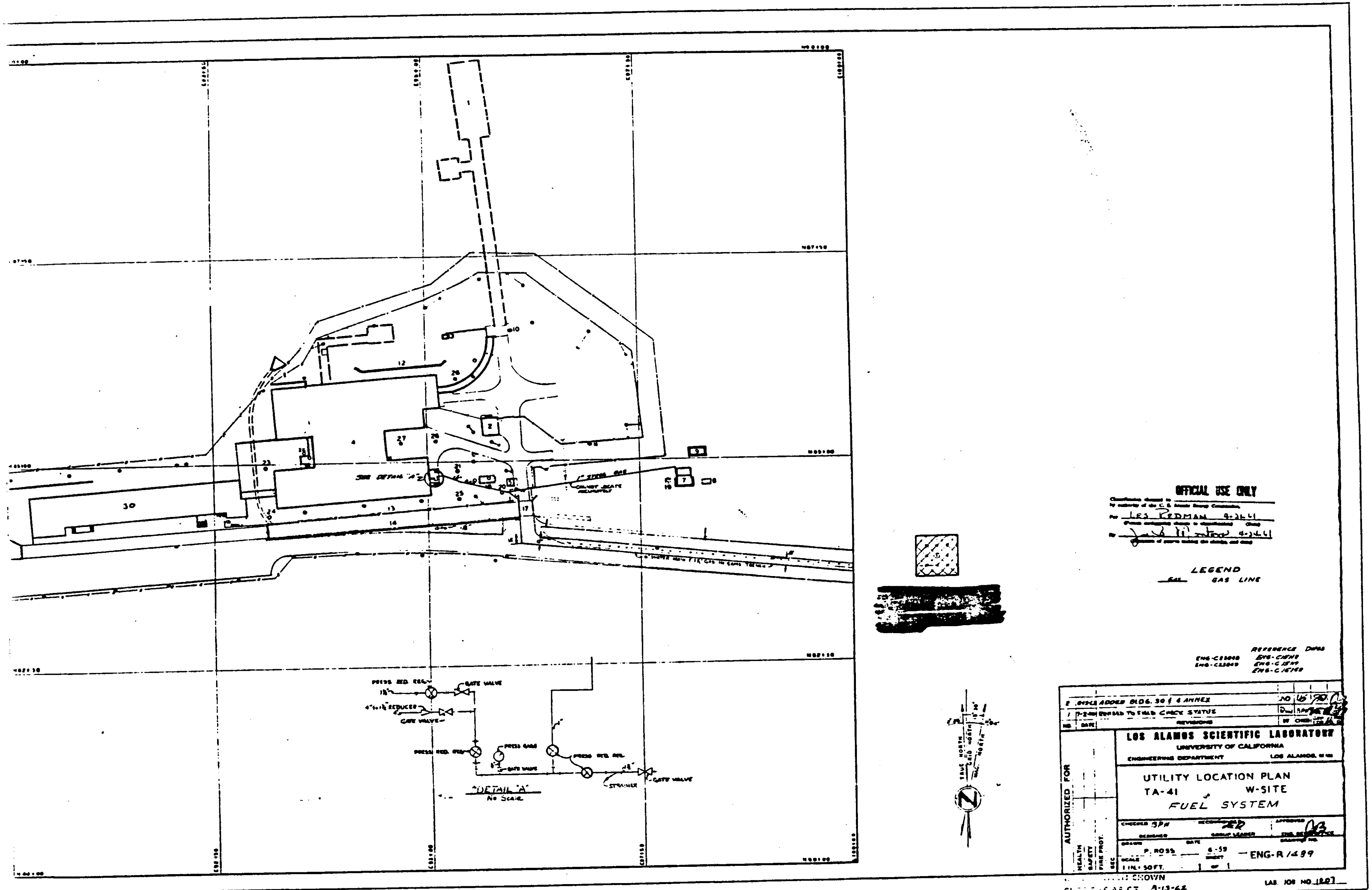
AUTHORIZED FOR: HEALTH, SAFETY, FIRE PROT., SEC.

UTILITY LOCATION PLAN
TA-41 W-SITE
WATER SYSTEM

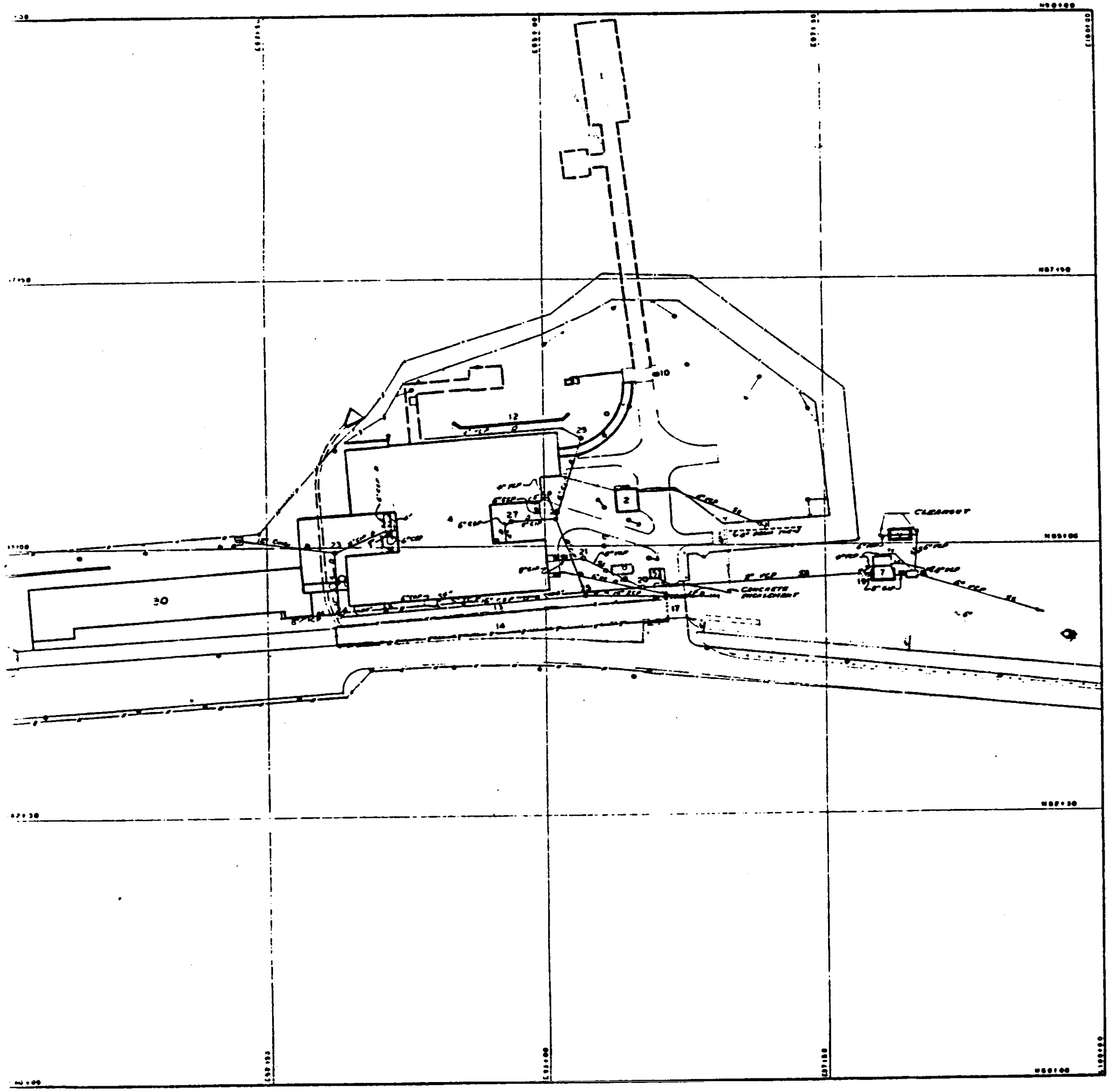
CHECKED SPN
DRAWN P. ROSS — DATE 6-59
SCALE 1 IN. = 50 FT. — SHEET 1 of 1
ENG-R 1488

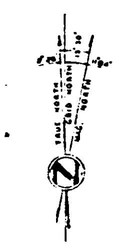
... SHOWN
... AS OF 8-15-62

LAB. JOB NO. 1207


OFFICIAL USE ONLY
LES REDMAN 4-26-61
LEGEND
GAS LINE
REFERENCE DWGS
SEE DETAIL "A"
"DETAIL 'A'"
No Scale
PRESS RED. REG.
GATE VALVE
REDUCER
PRESS GAGE
STRAINER
30
LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
ENGINEERING DEPARTMENT
LOS ALAMOS, N. M.
UTILITY LOCATION PLAN
TA-41 W-SITE
FUEL SYSTEM
AUTHORIZED FOR
HEALTH
SAFETY
FIRE PROT.
P. ROSS
ENG-R 1489
CURRENT AS OF 8-13-62
LAB. JOB NO.

[redacted]





[redacted]

OFFICIAL USE ONLY

Les Redman

LEGEND

SS — SANITARY SEWER
D — STORM DRAIN

ENG-C23848
ENG-C23849

REFERENCE DWGS.
ENG-C 1749
ENG-C 15150
ENG-C 1598

NO.	DATE	REVISIONS
2	8-4-66	ADDED BLDG. 30 & ANNEX
1		~~READING FOR BLDG.~~ TO FIELD CHECK STATUS OF 10-4-56

AUTHORIZED FOR: HEALTH, SAFETY, FIRE PROT., SEC.

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
ENGINEERING DEPARTMENT — LOS ALAMOS, N. M.

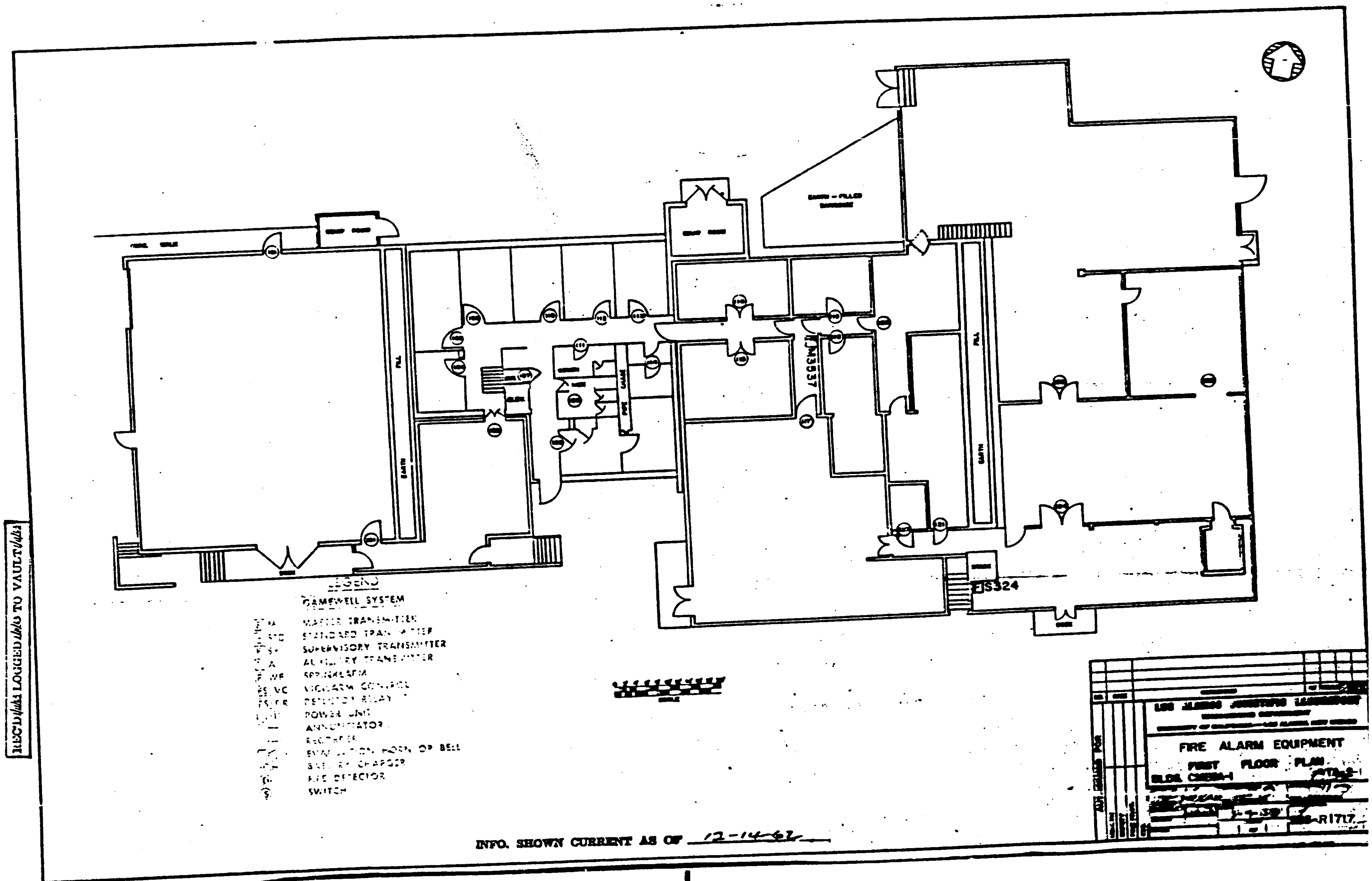
UTILITY LOCATION PLAN
TA-41 - W-SITE
SEWER SYSTEM

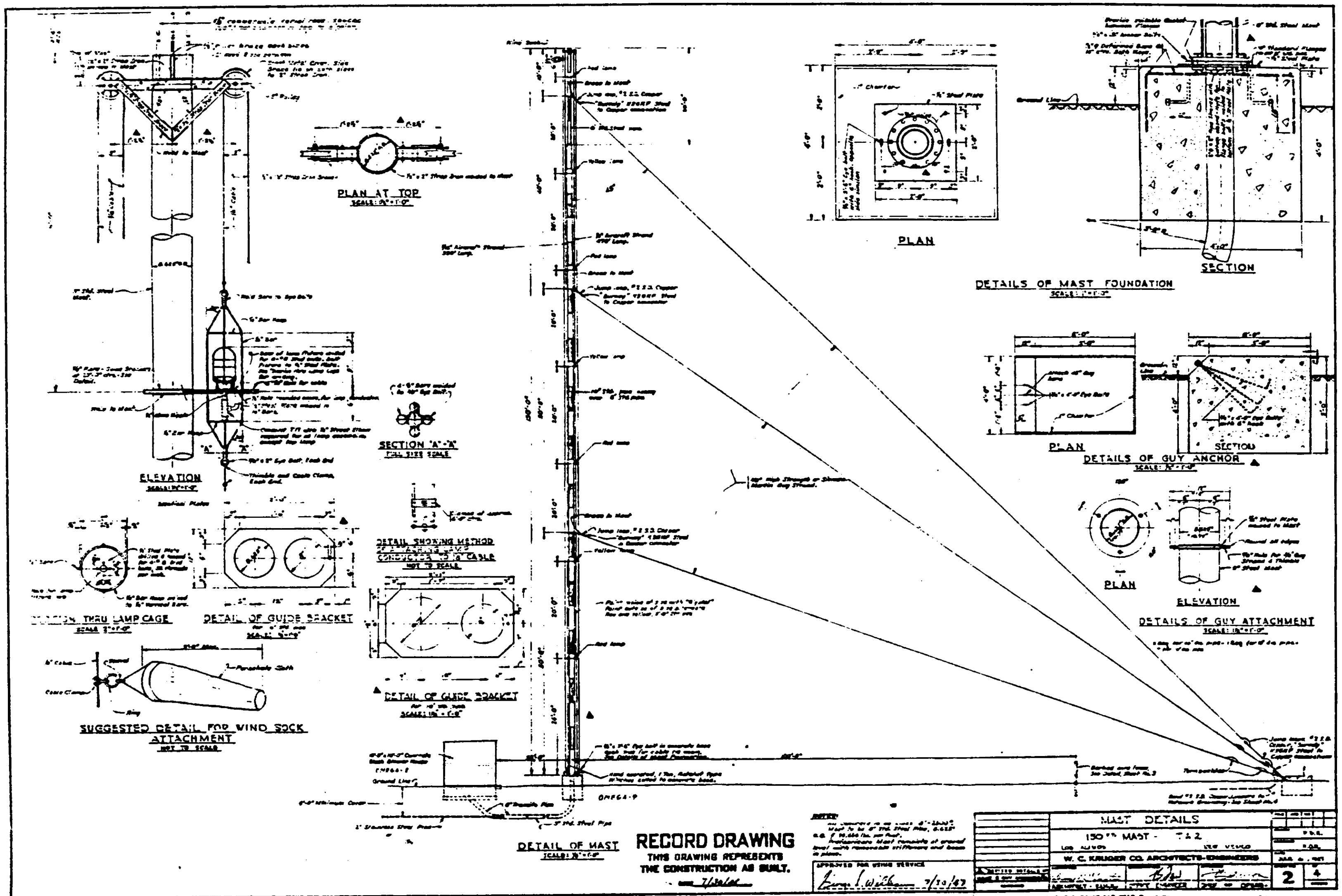
CHECKED: BPW
DRAWN: P. ROSS — DATE: 6-59
SCALE: 1 IN. = 50 FT. — SHEET 1 OF 1

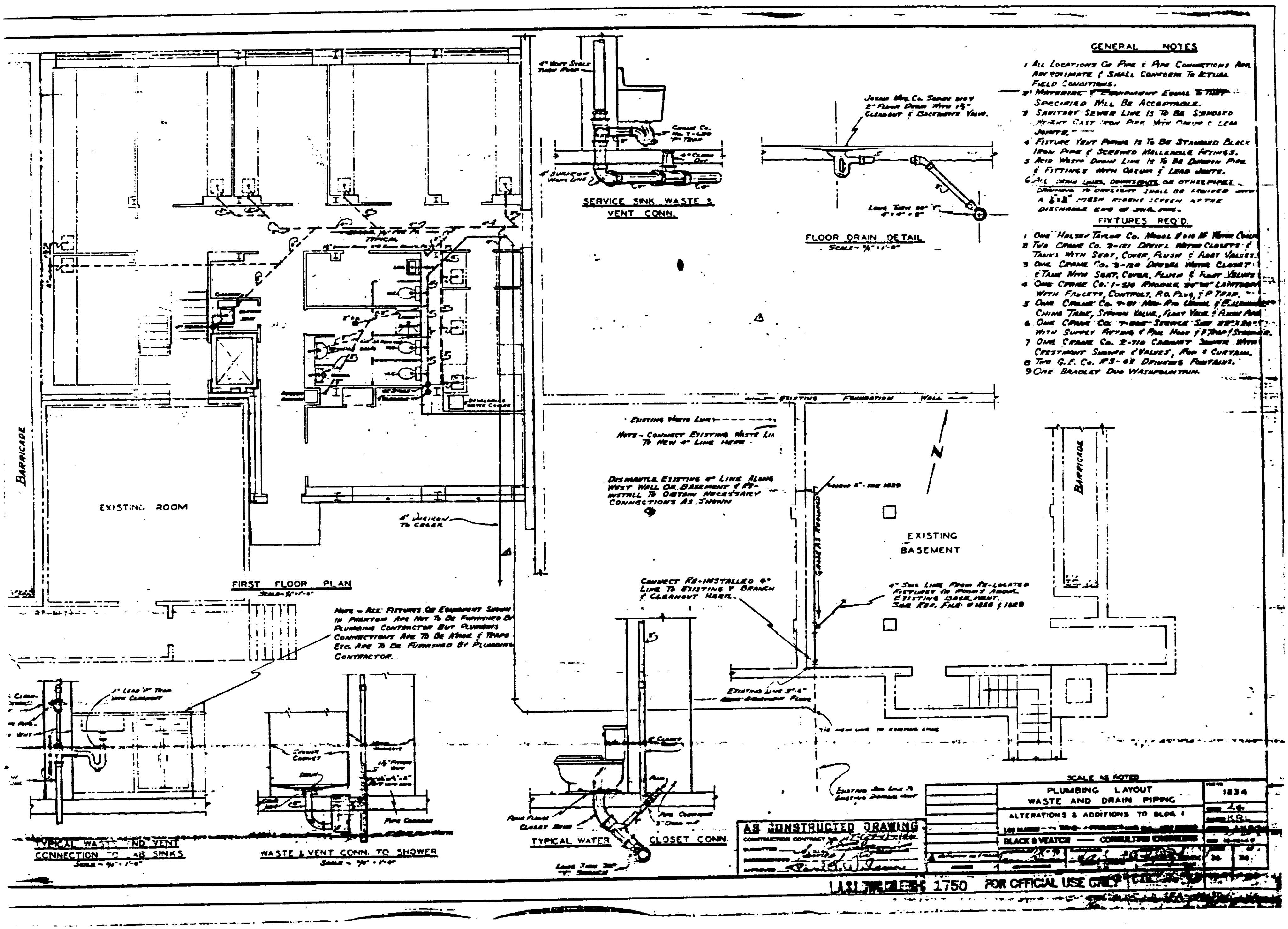
ENG-R 1490

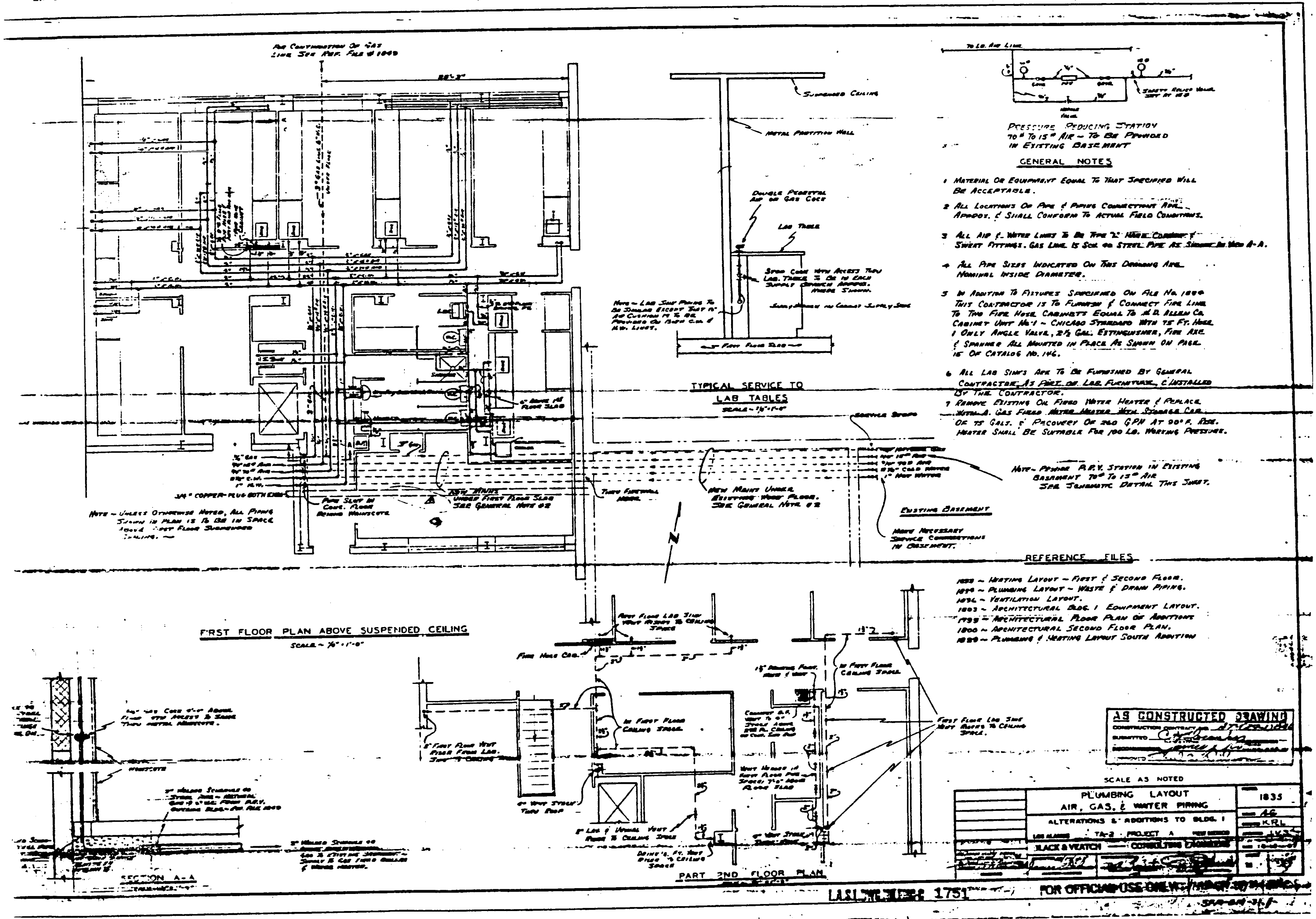
INFORMATION SHOWN CURRENT AS OF 8-13-66

LAB. JOB NO. 1207


EARTH - FILLED
FILL
EARTH
PIPE CHASE
EJM3537
EJS324
LEGEND
GAMEWELL SYSTEM
MASTER TRANSMITTER
STANDARD TRANSMITTER
SUPERVISORY TRANSMITTER
AUXILIARY TRANSMITTER
SPRINKLER
POWER UNIT
ANNUNCIATOR
RECTIFIER
EVACUATION HORN OR BELL
BATTERY CHARGER
FIRE DETECTOR
SWITCH
FIRE ALARM EQUIPMENT
FIRST FLOOR PLAN
INFO. SHOWN CURRENT AS OF 12-14-62
R1717


PLAN AT TOP
ELEVATION
SECTION "A"-"A"
FULL SIZE SCALE
SECTION THRU LAMP CAGE
DETAIL OF GUIDE BRACKET
DETAIL SHOWING METHOD
SUGGESTED DETAIL FOR WIND SOCK ATTACHMENT
NOT TO SCALE
DETAIL OF MAST
PLAN
SECTION
DETAILS OF MAST FOUNDATION
DETAILS OF GUY ANCHOR
DETAILS OF GUY ATTACHMENT
ELEVATION
RECORD DRAWING
THIS DRAWING REPRESENTS
THE CONSTRUCTION AS BUILT.
MAST DETAILS
150 FT MAST - TA 2
W. C. KRUGER CO. ARCHITECTS-ENGINEERS
APPROVED FOR USING SERVICE
2
4
L.A.S.L. ENG-C 1717 SFA-AL-1/2.1


GENERAL NOTES
1 All Locations Of Pipe & Pipe Connections Are Approximate & Shall Conform To Actual Field Conditions.
2 Material & Equipment Equal To That Specified Will Be Acceptable.
3 Sanitary Sewer Line Is To Be Standard Weight Cast Iron Pipe With Oakum & Lead Joints.
4 Fixture Vent Piping Is To Be Standard Black Iron Pipe & Screwed Malleable Fittings.
5 Acid Waste Drain Line Is To Be Duriron Pipe & Fittings With Oakum & Lead Joints.
FIXTURES REQ'D.
1 One Halsey Taylor Co. Model #610 BF Water Cooler
2 Two Crane Co. 3-121 Drivel Water Closets & Tanks With Seat, Cover, Flush & Float Valves.
3 One Crane Co. 3-120 Drivel Water Closet & Tank With Seat, Cover, Flush & Float Valves
4 One Crane Co. 1-510 Rhodes Lavatory With Faucets, Controls, P.O. Plug, & P Trap.
7 One Crane Co. 2-710 Cabinet Shower With Crestmont Shower & Valves, Rod & Curtain.
8 Two G.E. Co. FS-63 Drinking Fountains.
9 One Bradley Duo Washfountain.
SERVICE SINK WASTE & VENT CONN.
FLOOR DRAIN DETAIL
FIRST FLOOR PLAN
EXISTING ROOM
BARRICADE
EXISTING BASEMENT
BARRICADE
N
Existing Foundation Wall
Existing Waste Line
Note - Connect Existing Waste Lin To New 4" Line Here
Dismantle Existing 4" Line Along West Wall Of Basement & Re-install To Obtain Necessary Connections As Shown
Connect Re-installed 6" Line To Existing Y Branch & Cleanout Here.
Note - All Fixtures Or Equipment Shown In Phantom Are Not To Be Furnished By Plumbing Contractor But Plumbing Connections Are To Be Made & Traps Etc. Are To Be Furnished By Plumbing Contractor.
TYPICAL WASTE AND VENT CONNECTION TO LAB SINKS
WASTE & VENT CONN. TO SHOWER
TYPICAL WATER CLOSET CONN.
AS CONSTRUCTED DRAWING
SCALE AS NOTED
PLUMBING LAYOUT
WASTE AND DRAIN PIPING
ALTERATIONS & ADDITIONS TO BLDG. 1
BLACK & VEATCH — CONSULTING ENGINEERS
1834
FOR OFFICIAL USE ONLY
1750


PRESSURE REDUCING STATION
70# TO 15# AIR – TO BE PROVIDED IN EXISTING BASEMENT
GENERAL NOTES
1 MATERIAL OR EQUIPMENT EQUAL TO THAT SPECIFIED WILL BE ACCEPTABLE.
2 ALL LOCATIONS OF PIPE & PIPING CONNECTIONS ARE APPROX. & SHALL CONFORM TO ACTUAL FIELD CONDITIONS.
3 ALL AIR & WATER LINES TO BE TYPE "L" HARD COPPER & SWEAT FITTINGS. GAS LINE IS SCH. 40 STEEL PIPE AS SHOWN IN VIEW A-A.
4 ALL PIPE SIZES INDICATED ON THIS DRAWING ARE NOMINAL INSIDE DIAMETER.
5 IN ADDITION TO FIXTURES SPECIFIED ON FILE NO. 1834 THIS CONTRACTOR IS TO FURNISH & CONNECT FIRE LINE TO TWO FIRE HOSE CABINETS EQUAL TO W.D. ALLEN CO. CABINET UNIT NO. 1 – CHICAGO STANDARD WITH 75 FT. HOSE, 1 ONLY ANGLE VALVE, 2½ GAL. EXTINGUISHER, FIRE AXE & SPANNER ALL MOUNTED IN PLACE AS SHOWN ON PAGE 15 OF CATALOG NO. 146.
6 ALL LAB SINKS ARE TO BE FURNISHED BY GENERAL CONTRACTOR AS PART OF LAB. FURNITURE, & INSTALLED BY THE CONTRACTOR.
7 REMOVE EXISTING OIL FIRED WATER HEATER & REPLACE WITH A GAS FIRED WATER HEATER WITH STORAGE CAP. OF 75 GALS. & RECOVERY OF 260 GPH AT 90° F. RISE. HEATER SHALL BE SUITABLE FOR 100 LB. WORKING PRESSURE.
NOTE – PROVIDE P.R.V. STATION IN EXISTING BASEMENT 70# TO 15# AIR SEE SCHEMATIC DETAIL THIS SHEET.
EXISTING BASEMENT
MAKE NECESSARY SERVICE CONNECTIONS IN BASEMENT.
REFERENCE FILES
– HEATING LAYOUT – FIRST & SECOND FLOOR.
– PLUMBING LAYOUT – WASTE & DRAIN PIPING.
– VENTILATION LAYOUT.
1803 – ARCHITECTURAL BLDG. 1 EQUIPMENT LAYOUT.
– ARCHITECTURAL FLOOR PLAN OF ADDITIONS
1800 – ARCHITECTURAL SECOND FLOOR PLAN.
– PLUMBING & HEATING LAYOUT SOUTH ADDITION
TYPICAL SERVICE TO LAB TABLES
SUSPENDED CEILING
METAL PARTITION WALL
DOUBLE PEDESTAL AIR OR GAS COCK
LAB TABLE
FIRST FLOOR PLAN ABOVE SUSPENDED CEILING
NOTE – UNLESS OTHERWISE NOTED, ALL PIPING SHOWN IN PLAN IS TO BE IN SPACE ABOVE FIRST FLOOR SUSPENDED CEILING.
3/4" COPPER-PLUG BOTH ENDS
NEW MAINS UNDER EXISTING WOOD FLOOR. SEE GENERAL NOTE #2
FOR CONTINUATION OF GAS LINE SEE REF. FILE # 1849
PART 2ND FLOOR PLAN
FIRST FLOOR LAB SINK VENT RISERS TO CEILING SPACE.
FIRE HOSE CAB.
SECTION A-A
AS CONSTRUCTED DRAWING
CONSTRUCTION CONTRACT NO.
SUBMITTED
SCALE AS NOTED
PLUMBING LAYOUT
AIR, GAS, & WATER PIPING
ALTERATIONS & ADDITIONS TO BLDG. 1
TA-2 · PROJECT A
BLACK & VEATCH — CONSULTING ENGINEERS
1835
AG
KRL
1751
FOR OFFICIAL USE ONLY

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	APPROXIMATE GRID LOCATION
TA-2-1	[illegible]	MAIN BUILDING		N85+00 E115+00
TA-2-2	[illegible]		REMOVED 1948	
TA-2-3	OMEGA-3		REMOVED 1971	
TA-2-4	OMEGA-4	LABORATORY BUILDING		N82+50 E112+50
TA-2-5	OMEGA-5		REMOVED 1948	
TA-2-6	[illegible]		REMOVED 1960	
TA-2-7	[illegible]		REMOVED 1950	
TA-2-8	[illegible]	[illegible]ER HOUSE		N75+00 E117+50
TA-2-9	[illegible]	MAST		N75+00 E120+00
TA-2-10	OMEGA-10		REMOVED 1949	
TA-2-11	OMEGA-11		REMOVED 1949	
TA-2-12	OMEGA-12		REMOVED 1955	
TA-2-13	OMEGA-13		REMOVED 1950	
TA-2-14	OMEGA-14		REMOVED 1950	
TA-2-15	OMEGA-15		REMOVED 1946	
TA-2-16	[illegible]		REMOVED 1958	
TA-2-17	[illegible]A-17		REMOVED 1950	
TA-2-18	[illegible]		REMOVED 1950	
TA-2-19	[illegible]	STACK GAS VAL[illegible] HOUSE		N85+00 E117+50
TA-2-20	[illegible]		REMOVED 1950	
TA-2-21	OMEGA-21	WATER LINE VALVE HOUSE		N85+00 E112+50
TA-2-22	OMEGA-22	EAST BRIDGE		N85+00 E117+50
TA-2-23	OMEGA-23	WEST BRIDGE		N85+00 E112+50
TA-2-24	OMEGA-24	RETAINING WALL	NORTH BANK	N85+00 E115+00
TA-2-25	OMEGA-25	RETAINING WALL	SOUTH BANK	N85+00 E112+50
TA-2-26	OMEGA-26	SALVAGE BASIN	ABANDONED 1953	N85+00 E115+00
TA-2-27	OMEGA-27	DROP INLET		N85+00 E112+50
TA-2-28	OMEGA-28	SURFACE INLET		N85+00 E112+50
TA-2-29	[illegible]		FUEL, REMOVED 1950	
TA-2-30	[illegible]	BEAM TRAP		N85+00 E115+00
TA-2-31	[illegible]		REMOVED 1950	
TA-2-32	OMEGA-32	UNDERGROUND CHAMBER		N85+00 E115+00
TA-2-33	OMEGA-33	PIPE TRENCH	ABANDONED 1973	N85+00 E115+00
TA-2-34	OMEGA-34		REMOVED 1945	
TA-2-35	OMEGA-35	DRAINAGE BASIN		N85+00 E117+50
TA-2-36	OMEGA-36	DROP INLET		N85+00 E112+50
TA-2-37	OMEGA-37	ROCK CATCHER		N87+50 E115+00
TA-2-38	OMEGA-38	STREAM DEBRIS CATCHER		N85+00 E112+50
TA-2-39	OMEGA-39	STREAM DEBRIS CATCHER		N85+00 E117+50
TA-2-40	OMEGA-40	MANHOLE	GAS P.R.V.	N85+00 E115+00
TA-2-41	OMEGA-41	RETAINING WALL		N85+00 E115+00
TA-2-42	OMEGA-42		CANCELLED	
TA-2-43	OMEGA-43	TANK	SEPTIC	N8[illegible]+00 E117+50
TA-2-44	OMEGA-44	EQUIPMENT BUILDING		N[illegible]+00 E112+50
TA-2-45	OMEGA-45		REMOVED 1960	
TA-2-46	OMEGA-46	TANK	SURGE	N85+00 E112+50
TA-2-47	OMEGA-47	MANHOLE	WATER	N85+00 E112+50
TA-2-48	OMEGA-48	MANHOLE	ACID	N85+00 E117+50
TA-2-49	OMEGA-49	COOLING TOWER		N85+00 E112+50
TA-2-50	OMEGA-50	STORAGE BUILDING		N85+00 E117+50
TA-2-51	OMEGA-51	SUBSTATION		N85+00 E112+50
TA-2-52	OMEGA-52		REMOVED 1968	
TA-2-53	OMEGA-53	PIT	ACID	N85+00 E112+50
TA-2-54	OMEGA-54	TANK	ACID, UNDERGROUND	N85+00 E112+50
TA-2-55	OMEGA-55	TANK	ACID, UNDERGROUND	N85+00 E112+00
TA-2-56	OMEGA-56	TANK	ACID, UNDERGROUND	N85+00 E112+00
TA-2-57	OMEGA-57	VALVE HOUSE		N85+00 E112+50
TA-2-58	OMEGA-58	STACK MONITORING BUILDING		N75+00 E117+50
TA-2-59	OMEGA-59	TRANSFORMER STATION		N75+00 E120+00
TA-2-60	OMEGA-60	TRANSFORMER STATION	SERIES LIGHTING	N85+00 E112+50
TA-2-61	OMEGA-61	METERING STATION	LOC. 2 SPANS SW OF OMEGA-60	
TA-2-62	OMEGA-62	EFFLUENT HOLDING TANK	(UNDERGROUND)	N85+00 E117+50
TA-2-63	OMEGA-63	UTILITY BUILDING		N85+00 E115+00

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	APPROXIMATE GRID LOCATION
TA-0-1	ULR-1	MANHOLE	WATER	N85+00 E112+50

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	APPROXIMATE GRID LOCATION

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CLASS U DATE

NO.	DATE	REVISIONS	BY
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13	12-10-70	REVISED TO STATUS OF 12-10-70	BAD
12	8-6-69	REVISED TO STATUS OF 8-5-69	BAD
11	10-13-65	REVISED TO STATUS OF 9-4-65	ERM
10	8-15-61	REDRAWN TO STATUS OF 8-1-61 (WAS ENG-R[illegible])	DDS

AUTHORIZED FOR: HEALTH / SAFETY / FIRE PROT. / SEC.

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ENGINEERING DEPARTMENT
UNIVERSITY OF CALIFORNIA — LOS ALAMOS NEW MEXICO

INDEX SHEET
STRUCTURE LOCATION PLAN
TA-2 OMEGA SITE

DRAWN: J.D. SIMES
SCALE: NONE
DATE: 8-15-61
SHEET 1 OF 2
ENG-R 2408

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	APPROXIMATE GRID LOCATION
TA-41-1	W-1	UNDERGROUND VAULT		N 90+00 E 95+00
TA-41-2	W-2	GUARD HOUSE		N 85+00 E 95+00
TA-41-3	W-3	BLOWER HOUSE		N 87+50 E 95+00
TA-41-4	W-4	LABORATORY BUILDING		N 85+00 E 95+00
TA-41-5	W-5	GUARD HOUSE		N 85+00 E 95+00
TA-41-6	W-6	COVERED PASSAGEWAY	BLDG. 1 TO BLDG. 4	N 85+00 E 95+00
TA-41-7	W-7	IMHOFF TANK & CHLORINE ROOM	SEWAGE PLANT	N 85+00 E 97+50
TA-41-8	W-8	TANK, CONTACT	SEWAGE PLANT	N 85+00 E 97+50
TA-41-9	W-9	DRYING BED	SEWAGE PLANT	N 85+00 E 97+50
TA-41-10	W-10	SUMP PIT	ABANDONED [illegible]	N 87+50 E 95+00
TA-41-11	W-11	TANK, SEPTIC		N 85+00 E 97+50
TA-41-12	W-12	RETAINING WALL		N 85+00 E [illegible]
TA-41-13	W-13	RETAINING WALL		N 85+00 E 95+00
TA-41-14	W-14	RETAINING WALL	INCORPORATED IN TA-41-31	N 85+00 E 95+00
TA-41-15	W-15	BRIDGE		
TA-41-16	W-16	GUARD HOUSE		N 85+00 E [illegible]
TA-41-17	W-17	BRIDGE		N 85+00 E 95+00
TA-41-18	W-18	MANHOLE	WATER P.R.V.	N 85+00 E 95+00
TA-41-19	W-19	MANHOLE	SANITARY	N 85+00 E 97+50
TA-41-20	W-20	MANHOLE	SANITARY	N 85+00 E 95+00
TA-41-21	W-21	MANHOLE	SANITARY	N 85+00 E 95+00
TA-41-22	W-22	MANHOLE	STORM DRAINAGE	N 85+00 E 92+50
TA-41-23	W-23	MANHOLE	STORM DRAINAGE	N 85+00 E 92+50
TA-41-24	W-24	MANHOLE	STORM DRAINAGE	N 85+00 E 92+50
TA-41-25	W-25	MANHOLE	STORM DRAINAGE	N 85+00 E 95+00
TA-41-26	W-26	MANHOLE	STORM DRAINAGE	N 85+00 E 95+00
TA-41-27	W-27	MANHOLE	STORM DRAINAGE	N 85+00 E 95+00
TA-41-28	W-28	MANHOLE	STORM DRAINAGE	N 85+00 E 95+00
TA-41-29	W-29	PASSAGEWAY		N 85+00 E 92+50
TA-41-30	W-30	ENGINEERING & LAB BLDG.		N 85+00 E 92+50
TA-41-31	W-31	BOX CULVERT		N 85+00 E 92+50
TA-41-32	W-32	RETAINING WALL		N 85+00 E 90+00
TA-41-33	W-33	RETAINING WALL		N 85+00 E 90+00
TA-41-34	W-34	BRIDGE		N 85+00 E 95+00
TA-41-35	W-35	MANHOLE	SANITARY	N 85+00 E 92+50
TA-41-36	W-36	BRIDGE		N 85+00 E 97+50
TA-41-37	W-37	RETAINING WALL		N 85+00 E 97+50
TA-41-38	W-38	TRANSFORMER STATION		N 95+00 E 95+00
TA-41-39	W-39	TRANSFORMER STATION		N 85+00 E 90+00
TA-41-40	W-40	TRANSFORMER STATION		N 85+00 E 100+00
TA-41-41	W-41	METERING STATION		N 85+30 E 90+00
TA-41-42	W-42	GUARD BUILDING		N 82+50 E 97+50

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	APPROXIMATE GRID LOCATION

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	GRID LOCATION

REVIEWER DW Parker
CLASS U DATE 1/20/72

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10	9-11-95	REVISED TO STATUS OF 9-1-95
9	8-15-61	REDRAWN TO STATUS OF 8-1-61 (WAS ENG-[illegible])

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LOS ALAMOS SCIENTIFIC LABORATORY
ENGINEERING DEPARTMENT
UNIVERSITY OF CALIFORNIA — LOS ALAMOS, NEW MEXICO

INDEX SHEET
STRUCTURE LOCATION PLAN
TA-41 W-SITE

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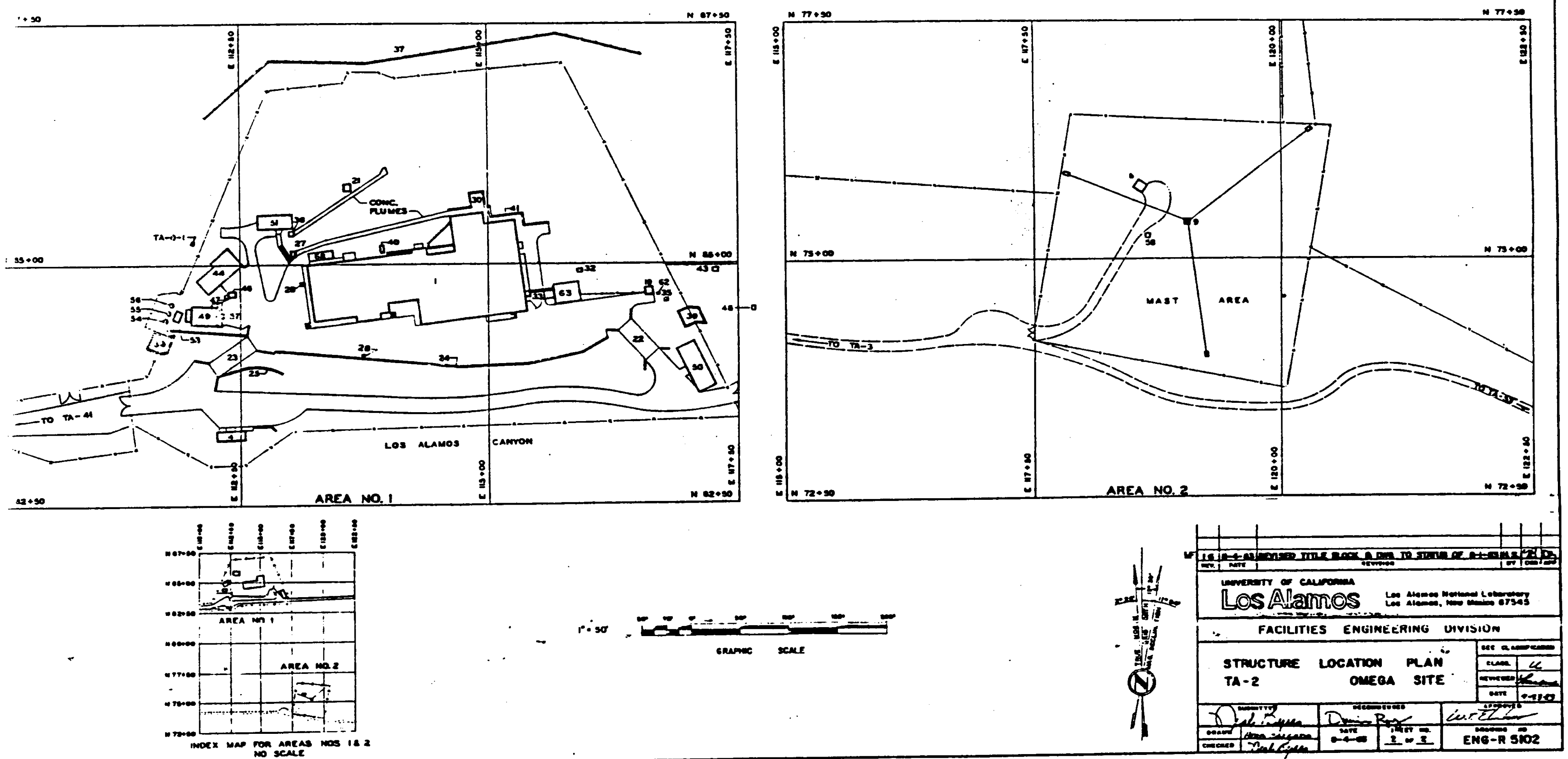
SCALE: NONE | SHEET: 1 of 2



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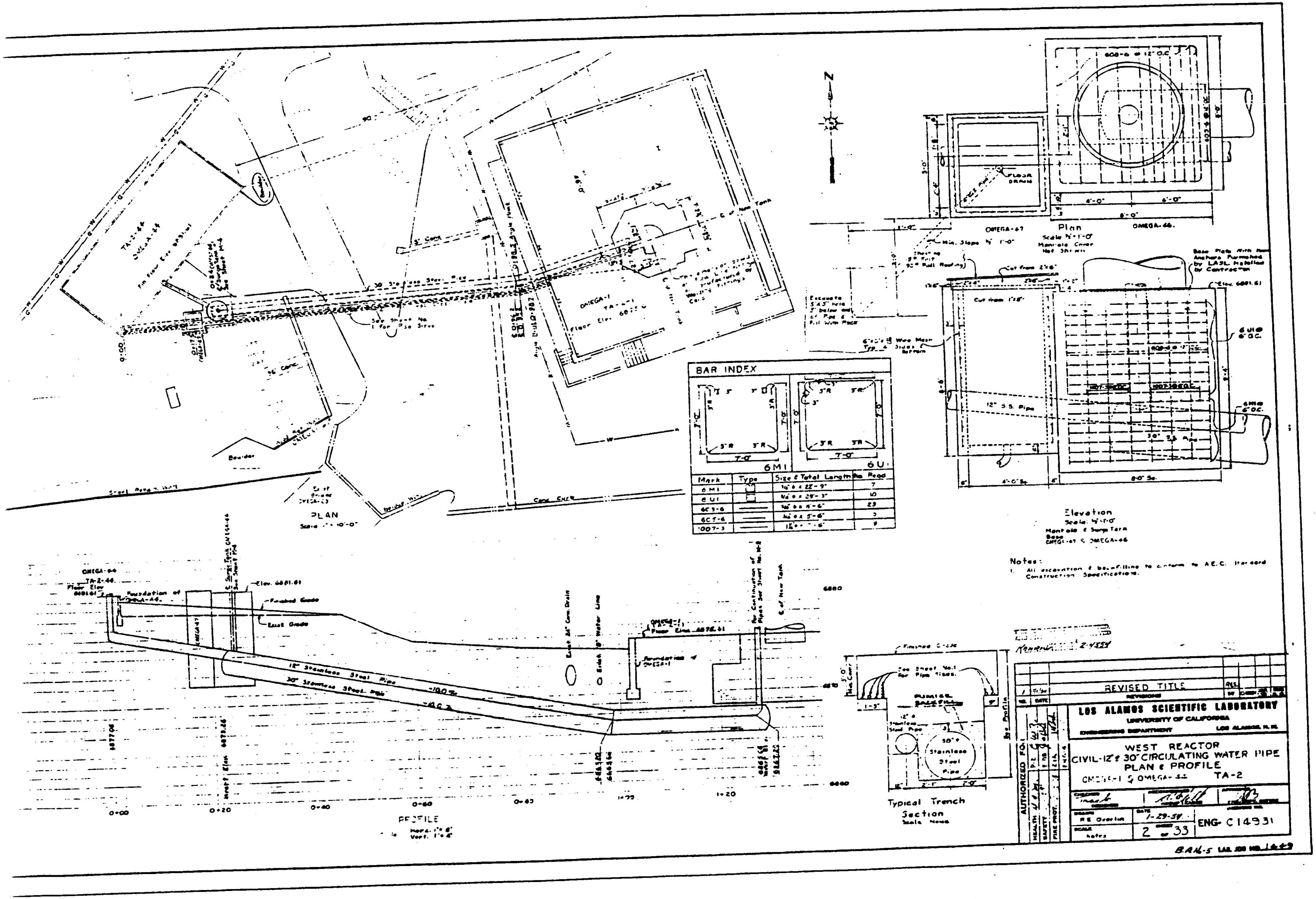
UNIVERSITY OF CALIFORNIA
Los Alamos — Los Alamos National Laboratory, Los Alamos, New Mexico 87545

FACILITIES ENGINEERING DIVISION

STRUCTURE LOCATION PLAN
TA-2 OMEGA SITE

Date: 8-4-65
Sheet 2 of 2
Drawing No. ENG-R 5102

TO VAULT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PROFILE
Typical Trench
Section
Scale None
Plan
Scale ½"=1'-0"
Manhole Cover
Not Shown
OMEGA-47
OMEGA-46
Elevation
Scale ½"=1'-0"
Manhole & Surge Tank
Base
Notes:
1. All excavation & backfilling to conform to A.E.C. Standard Construction Specifications.
12" Stainless Steel Pipe
30" Stainless Steel Pipe
12" S.S. Pipe
30" S.S. Pipe
OMEGA-1
Finished Grade
Exist. Grade
Foundation of OMEGA-1
Floor Drain
Boulder
BAR INDEX
6M1
6U
Mark | Type | Size & Total Length | No. Reqd
6M1 | | ¾" ɸ x 22'-9" | 7
6U1 | | ¾" ɸ x 29'-3" | 10
6C3-6 | | ¾" ɸ x 11'-6" | 23
6C5-6 | | ¾" ɸ x 5'-6" | 3
1007-3 | | 1¼" ɸ x 7'-6" | 9
REVISED TITLE
REVISIONS
LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
ENGINEERING DEPARTMENT
LOS ALAMOS, N. M.
WEST REACTOR
CIVIL-12" & 30" CIRCULATING WATER PIPE
PLAN & PROFILE
TA-2
AUTHORIZED FOR
HEALTH
SAFETY
FIRE PROT.
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DATE
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Notes
2 of 33
ENG-C14931
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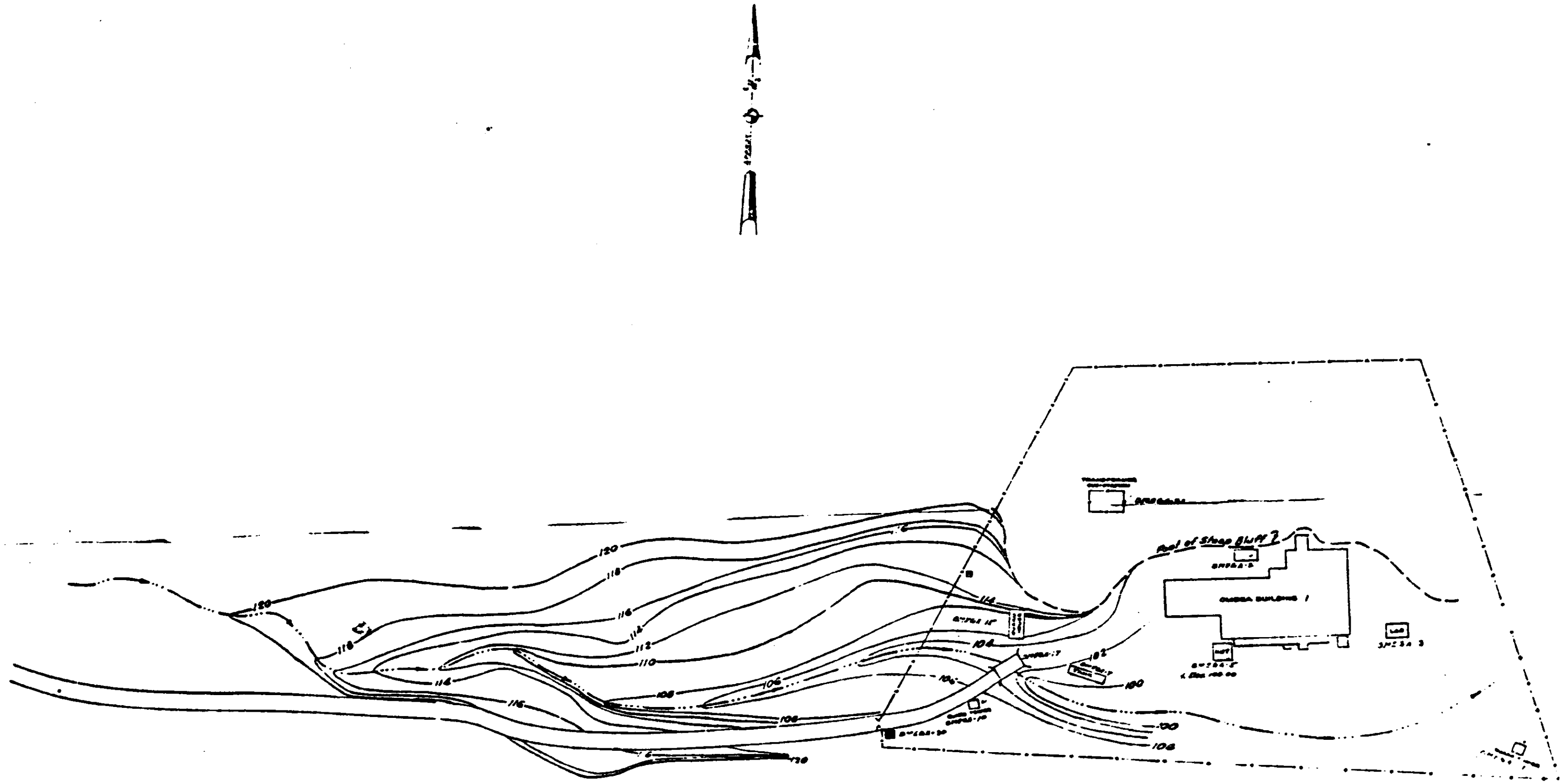


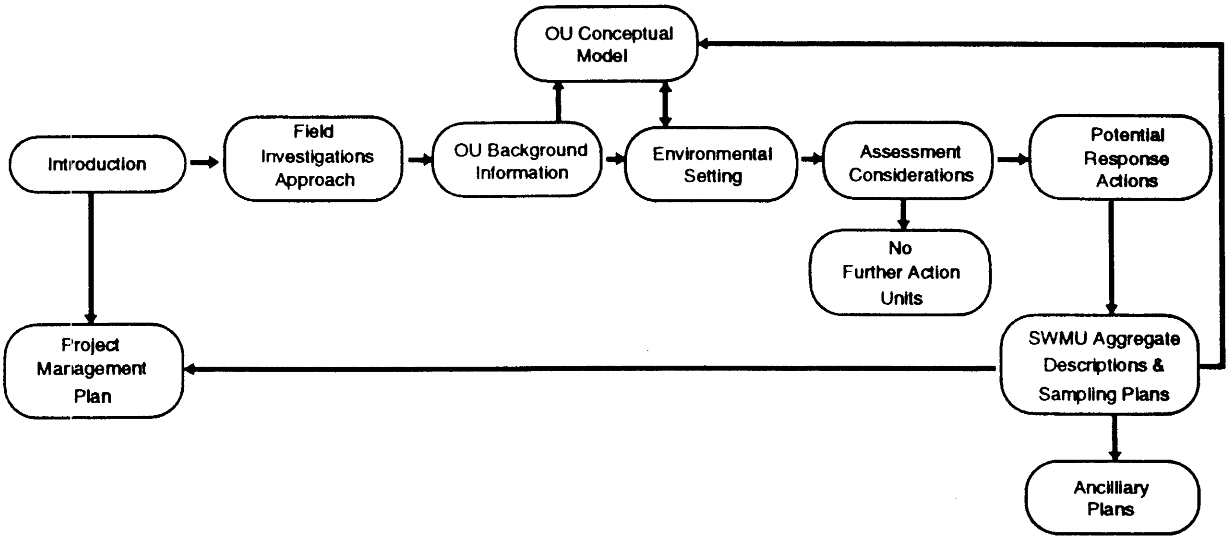
U. S. ENGINEER OFFICE
SANTA FE, NEW MEXICO

TOPOGRAPHY
OMEGA AREA

OFFICE OF POST ENGINEER

FILE NO. PE O-

APPENDIX C



Field and Laboratory Investigation Methods

CONTENTS

- Laboratory-required preliminary activities and support procedures,
- identification and documentation of sampling locations,
- sample handling and laboratory coordination procedures,
- equipment decontamination procedures, and
- management of wastes generated by sampling activities.

C.1.3 Investigation Methods

TA-2 and TA-41 field investigation methods are addressed in Section C.5 (Field Sampling Methods) of this appendix and are tiered to the Laboratory's Installation Work Plan (IWP) (LANL 1992, 0768) Standard Operating Procedures (SOPs) for methods to be used during the TA-2 and TA-41 RFI are summarized in Table 7.3-1 and Table 5.5 of the OU 1098 QAPjP (Annex II) of this OU work plan. The methods presented in this chapter are specific examples of the options identified in the IWP. In addition, this chapter references the Laboratory's ER Program SOPs (LANL 1991, 0411). Each of the brief method descriptions given herein refers to the applicable SOPs for detailed methodology. The methods described in Sections C.4 through C.8 in this chapter include:

- sampling methods;
- field sample screening methods to identify grossly contaminated samples at the point of collection (Level I/II);
- *in situ* field survey methods to identify gross contamination areas (Level I/II/III);
- field laboratory measurement methods to provide rapid quantitative or semi-quantitative sample analyses (Level II/III); and
- offsite analytical laboratory methods (Level III).

The method descriptions are brief and provide some specific information that defines the application. More specific information is provided by the individual field sampling plan (such as sampling location or target depth of a borehole). The method descriptions presented here are not intended to supplant or reduce the importance of the Quality Assurance Project Plan (Annex II of this OU work plan) and the governing SOPs (LANL 1991, 0411).

C.1.4 Data Analysis

Section C.10 of this chapter gives a general discussion of data analysis concepts that will be applied in assessing the meaning of collected information. These concepts include:

- comparisons of sample contaminant levels and screening

APPENDIX C

Field and Laboratory Investigation Methods

C.1 Introduction

C.1.1 Approach

This chapter has been prepared to describe, in one place, the common elements that apply to the conduct of field investigations at all TA-2 and TA-41 SWMUs. The objectives and technical approach for investigations at the TA-2 and TA-41 OU are described in Chapters 1-8 of this work plan. Key concepts presented there include:

1. OU-wide investigations which focus on general environmental characteristics and ambient levels of contaminant indicators. These investigations provide the framework within which SWMU-specific data will be evaluated.
2. SWMU-specific characterization which focuses on the nature and extent of contamination and the potential for future migration of waste.
3. Identification and planning of explicit phases of investigation.
4. Evaluation of analytical data and reassessment of data needs at intermediate stages (according to the decision analysis and observational approaches).

Listed below are several general concepts that apply to most of the TA-2 and TA-41 field investigations.

1. Radiological contamination is a general characteristic of TA-2 and TA-41 and a primary focus of SWMU-specific investigations.
2. For all TA-2 and TA-41 SWMUs, release of any hazardous constituents would have been generally associated with the release of radioactive materials.
3. Field surveys and field screening of samples can be used to identify gross contamination and can serve as Level I/II data.
4. Field laboratory analyses can be used to quickly provide Level II/III data to help guide field operations.

C.1.2 Field Operations

This appendix identifies aspects of the Laboratory's implementation of the RFI that are not duplicated in the SWMU-specific field sampling plans. Such aspects include the standard activities that will be used to support field operations as follows:

C.2.3 Support Services

Physical services support during the field investigation will be provided by Laboratory support groups ENG-3, ENG-5, Johnson Controls, or contractors. Existing job ticket procedures will be used. The services these groups will provide include, but are not limited to, back-hoe and front-end loader excavations, moving pallets of drummed auger cuttings and decontamination solutions, and setting up signs and other warning notices around the perimeter of the working area.

C.2.4 Excavation Permits

As part of the ES&H Questionnaire process, excavation permits are required by the Laboratory prior to any excavation, drilling, or other invasive activity. Acquisition of the permits will be coordinated with HSE-3 and Johnson Controls. Acquisition of excavation permits will be scheduled as appropriate for each phase of field work. All areas intended for excavation, drilling, or sampling deeper than 18 in. will be marked in the field for formal clearance prior to the work.

C.2.5 Sample Control and Documentation

Guidance for sample handling is provided in Section 13 of Annex II of the IWP. Sample packaging, handling, chain of custody, and documentation procedures are provided in the ER Program SOPs as follows:

- General Instructions for Field Personnel
- Containers, Sampling, and Preservation
- Guide to Handling, Packaging, and Shipping of Samples
- Sample Control and Documentation

C.2.6 Sample Coordination

A sample coordination facility has been established by the ER Program in Laboratory group EM-9 to provide consistency for all investigations. The system is detailed in Appendix N of the IWP. The applicable SOP is:

- Sample Control and Documentation

C.2.7 Quality Assurance Samples

Field quality assurance (QA) samples of several types are collected during the course of a field investigation. The definition for each kind of sample and the purpose it is intended to fulfill are given in Annex II, Quality Assurance Project Plan (QAPjP) of this OU work plan. The frequency with which each type of field action levels;

- decisions to conduct additional sampling or to stop sampling;
- role of the decision analysis and observational approaches; and
- statistical methods.

C.2 Field Operations

As indicated in the project schedule (Annex I of this OU work plan), several investigations may be conducted concurrently at TA-2 and TA-41. Field investigation teams will have individual responsibilities for health and safety, sample identification, sample handling and chain of custody, and related activities. Other operations may be shared across field teams, such as the field laboratory or an equipment decontamination facility.

A field laboratory will be operated to perform all field laboratory analyses required by the site characterization plans described in Chapter 7. The field laboratory will be managed independently to assure rigorous QA/QC.

In this section, several aspects of field operations are described that are part of many TA-2 and TA-41 OU field operations. The applicability of this assumption to each sampling plan in Chapter 7 is implied and is not restated elsewhere in this OU work plan.

C.2.1 Health and Safety

Annex III of this OU work plan presents the Health and Safety Plan for OU 1098 RFI field activities. The plan gives SWMU-specific information regarding known or suspected contaminants and personnel protection required for different activities. All samples acquired under this work plan will be screened at the point of collection to detect gross contamination or conditions that may pose a threat to the health and safety of field personnel. The techniques listed in Section C.6 of this appendix, Field Sample Screening, will be used. In particular, gross alpha, gross beta, and gross gamma radiation surveys will be conducted. Applicable SOPs are contained in Chapter 2 of the ER Program SOP document (LANL 1991, 0411) and are referenced in Table 7.3-1 and Table 5.5 of the OU 1098 QAPjP (Annex II) of this OU work plan.

C.2.2 Archaeological, Cultural, and Ecological Evaluations

Prior to initiation of field work, as part of the Laboratory's ES&H Questionnaire process, archaeological, and ecological evaluations will be performed in all areas where the surface is to be disturbed, vegetation is to be removed, or invasive sampling is to be performed. Following the archaeological and ecological evaluations, a DOE Environmental Checklist (DEC) is expected to be issued. It is anticipated that the DEC will lead to a recommendation for a categorical exclusion before RFI field work begins at TA-2 and TA-41.

determine other properties of the sample. Usually, screening provides Level I data. Alpha radioactivity is a common target of field screening. Lithological logging of core samples also is included in this category.

3. Field Laboratory Measurements (or "field laboratory analyses"). These are sample analysis methods that require minimal sample preparation and are readily adaptable to mobile laboratory analytical equipment. These methods measure contaminants or other sample properties at better detection limits, with better precision, or for different contaminants than can be obtained with field screening techniques. Level II data are common, although Level I and Level III procedures are also used. Gross alpha/beta and gamma spectrometry measurements on dried soil samples is a typical example.
4. Offsite Analytical Laboratory Analysis. This category represents the primary analysis for which samples are collected, preserved, and sealed. Level III or IV data usually result. Analysis for Appendix IX inorganics is a typical application.

C.4 Field Surveys

Field surveys (defined above in Section C.3) typically are primarily scans of the land surface using direct reading or recording instruments. For this OU work plan, these surveys include radiological and geophysical surveys to identify and refine locations as indicated by other information and to identify the presence or absence of contaminants or structures in the field. In some plans, these techniques are used to identify locations for judgmental sampling. In other plans, they are used for preliminary assessment of areas where contaminants are not expected. While negative field survey results are not necessarily conclusive evidence of the absence of contaminants, they can greatly minimize the probability that gross contamination has been overlooked and can allow timely redirection of field sampling.

C.4.1 Radiological Surveys

Radiological survey methods are addressed in Appendix F of this OU work plan.

C.4.2 Geophysical Surveys

Field surveys will be performed with a metal detector to confirm the location of buried piping. The selected geophysical instrument will be able to detect all types of metal (ferrous and nonferrous) and will be capable of detecting a 2-in.diameter metal line buried at a depth of 5 ft. A geophysical survey to locate buried metal lines is typically performed by continuously observing the instrument meter response while walking along traverse lines that cross at a right angle over the suspected trend of the buried line. A typical spacing of the parallel traverse lines is 20 ft. The applicable SOP is:

QA sample is to be collected also is detailed in the field sampling plans in Chapter 7.

C.2.8 Equipment Decontamination

Decontamination is performed as a quality assurance measure and a safety precaution. It prevents cross contamination among samples and helps maintain a clean working environment for the safety of personnel. Sampling tools are decontaminated by washing, rinsing, and drying. The effectiveness of the decontamination process is documented through rinsate blanks submitted for laboratory analysis. Steam cleaning is used for large machinery, vehicles, auger flights, and coring tools used in borehole sampling. Decontamination fluids, including steam cleaning fluids, are considered wastes and must be collected and contained for proper disposal. The applicable SOP is:

- General Equipment Decontamination

C.2.9 Waste Management

This discussion is based on the guidance provided in Appendix B of the IWP. Wastes produced during characterization sampling activities may include borehole auger cuttings, excess sample, excavated soil from trenching, decontamination and steam-cleaning fluids, and disposable materials such as wipes, protective clothing, and spoiled sample bottles. In different areas of TA-2 and TA-41, several of the following waste categories have the potential to be encountered: hazardous wastes, low-level radioactive wastes, transuranic waste, and mixed waste (either low-level or transuranic mixed waste). Requirements for segregating, containing, characterizing, treating, and disposing of each type and category of waste are provided in the applicable SOP:

- RFI-Generated Waste Management

C.3 Survey, Screening and Analysis Methods

Consistent language has been adopted in this work plan to refer to four categories of measurements as defined below, to avoid confusion regarding the type of measurement being discussed.

1. Field Surveys (or "surveys"). Direct reading or recording instruments are used to scan the land surface to make measurements of *in situ* conditions. Typically, surveys provide Level I or II data. Gamma radioactivity is a common target of field surveys. Land surveys, geophysical surveys and borehole logging also are included in this category.
2. Field Screening ("field sample screening" or "screening"). Instruments or observations are applied to samples at the point of collection to measure the presence of gross contamination or

the ring sampler is then excavated so that the tube can be removed. An undisturbed core sample is obtained by pushing out the soil in the ring sampler. The applicable SOP is:

- Stainless Steel Surface Soil Sampler

C.5.2.3 Manual Shallow Core Sample

Small volume soil samples can be recovered from depths approaching 10 ft with a hand auger or with a thin-wall tube sampler. The thin-wall tube sampler provides a less disturbed sample than that obtained with a hand auger. However, it may not be possible to force the thin-wall tube sampler through some soil or tuff, and sampling with the hand auger may be the more viable alternative. Usually it is not practical to use a hand auger or thin-wall sampler at depths below 10 ft. The applicable SOP is:

- Hand Auger and Thin-Wall Sampler

C.5.3 Core Sampling Methods and Borehole Stopping Criteria

Split-barrel core sampling will be accomplished using an auger rig that drives a 4.25-in. internal diameter hollow-stem auger with 7.5-in. outer diameter auger flights. Soil samples will be collected using a 3.125-in. internal diameter, 5-ft continuous, split-barrel sampler. In each sampling plan, a nominal depth for each borehole is given. The borehole will be sampled to at least the nominal depth. If contamination is detected by field screening measurements in the last core interval above the nominal depth, drilling will continue until field screening shows no anomalies in two successive sample intervals. This stopping criterion will be applied as a means of ensuring that the maximum information on contaminant depth is acquired. Each sampling plan specifies an analytical plan for cores down to the nominal depth. The pattern set by the analytical plan will be followed for the complete depth of the borehole as determined by the stopping criterion.

C.5.3.1 Shallow Boreholes

Several TA-2 and TA-41 sampling plans call for core samples to be collected from shallow boreholes limited to depths of about 15 ft where minimal penetration of contaminants is expected. A 5-ft core interval is specified as the standard sample. For ease of setup and rapid drilling of shallow boreholes, the use of a light-weight drilling rig may be preferred over other methods.

The stopping criterion described in Section C.5.3 will be used as appropriate and the applicable SOP for shallow boreholes is:

- Hollow-Stem Auger

- General Surface Geophysics

C.4.3 Engineering Surveys

Engineering surveys will be used to document all sampling locations and to locate either former or buried structures (where needed). In all cases, the minimum precision requirements for the surveys are the same: plus or minus 1-ft horizontal and vertical. The conventional survey procedures used are documented by Laboratory Facilities Engineering organizations.

C.5 Field Sampling Methods

C.5.1 Introduction

For the field sampling plans used in this work plan, a suite of specific sampling methods has been selected, and the details of their use and application in the field have been defined. For example, a "surface soil sample" in this document is specifically defined as representing a 0- to 12-in. layer of soil collected by a hand scoop (see Subsection C.5.2.1), and a "core sample" is generally defined as a 5-ft core interval of a specified length (see Subsection C.5.3).

Setting these common definitions and using them uniformly in all of the OU 1098 field sampling plans provides several benefits: consistency of field operations, comparability of sample analysis results from location to location, and the ability to have each sampling plan refer to a method defined in this chapter without reproducing the information in each plan. For each method identified below, the specifically defined portion is detailed. However, complete specification of the method requires additional information that is referenced to the applicable SOP or provided in the field sampling plan (e.g., nominal or target depth for a borehole).

C.5.2 Soil Sampling Methods

C.5.2.1 Surface Soil Sample

Surface soil samples are defined as samples taken from the first 12 in. of soil. This type of soil sample will be gathered using a stainless steel or Teflon scoop. Care will be used to take the sample to a full 12 in. depth and to cut the sides of the hole vertically to ensure that equal volumes of soil are taken over the full 12-in. depth. The applicable SOP is:

- Spade and Scoop Method

C.5.2.2 Undisturbed Surface Soil Sample

Undisturbed soil samples will be gathered from the first 6 in. of soil using the ring sampler method. This method involves driving a 4-in.-diameter stainless steel tube (ring sampler) vertically into the area to be sampled. The soil around

Safety Project Plan) of this OU work plan. Every sample taken at TA-2 and TA-41 will be screened for gross alpha, beta, and gamma radioactivity. In addition, a noninstrumental form of sample screening, lithological logging, will be performed for all borehole samples.

C.6.1 Radiological Screening

C.6.1.1 Gross Alpha

Field screening of samples for gross alpha contamination is conducted using a hand-held alpha detector and a ratemeter. The detector is held close to the sample and is capable of detecting approximately 100-200 counts per minute for an undried sample. The instrument cannot identify specific radionuclides. The applicable SOP is:

- Total Alpha Surface Contamination Measurements

C.6.1.2 Gross Gamma

Field screening of samples for gamma radioactivity will be done using a hand-held gamma detector probe and ratemeter as a gross indicator of potential contamination. The detector is held close to the sample and is capable of identifying elevated concentrations of certain radionuclides as an increased ratemeter reading above instrument background levels. The applicable SOP is:

- Measurement of Gamma Radiation Using a Sodium Iodide (NaI) Detector

C.6.2 Nonradioactive Screening

C.6.2.1 Organic Vapor Detectors

Organic vapor detectors may be used to screen specified borehole cores and soil samples at the point of collection. Two purposes are addressed: personnel safety and the identification of grossly contaminated samples. Two types of detectors, PID and FID, are used to detect a wide range of vapors.

PID. A Model PI 101 photoionization detector (PID) or its equivalent will be used as needed to detect organic vapors. This general survey instrument is capable of detecting real-time concentrations of many complex organic compounds and some inorganic compounds in air. The instrument can be calibrated to a particular compound. However, it cannot distinguish between detectable compounds in a mixture of gases. The applicable SOP is:

- Health and Safety Monitoring of Organic Vapors with a Photoionization Detector

C.5.3.2 Deep Core Sampling

For tuff coring deeper than 150 to 200 ft, a drilling rig is needed with capabilities greater than those used for the hollow stem auger rigs described above. Initial plans presented in Chapter 7 call for two boreholes deeper than 200 ft. Section 7.3.4 describes the drilling and sampling strategy for these two boreholes. For deep drilling methods, the applicable SOP is:

- Drilling Methods and Drill Site Management

C.5.4 Surface Water Sampling Methods

A Geotech Model 0700 peristaltic pump, or its equivalent, will be used to collect surface water samples. The Geotech Model 0700 allows the union of the filtration assembly with the pump and the sample container so that collection of a representative sample is simplified and the possibility of sample contamination is reduced. In this method, surface samples are filtered and collected directly with minimal elapsed time.

An alternate method is to collect surface water as grab samples. This method involves dipping a beaker, flask, or some other transfer device into the surface water to retrieve samples. The water sample can also be collected directly by dipping the sample container into the water and filling, removing, and capping it. This method is less useful when sampling shallow waters such as seeps, springs, or shallow streams. The applicable SOP is:

- Surface Water Sampling

C.5.5 Groundwater Sampling

The sampling of the shallow and intermediate characterization boreholes at TA-2 and TA-41 is included in the general characterization of the OU. If perched water zones, springs, or seeps are encountered at TA-2 and TA-41, they also will be sampled. The applicable SOPs for groundwater sampling are:

- Purging of Wells for Representative Sampling of Ground Water
- Field Analytical Measurements on Ground Water Samples

C.6 Field Sample Screening

Field screening is defined earlier in Section C.3. Screening measurements are applied to samples at the point of surface sample collection, to assess conditions affecting the health or safety of field personnel. Application of screening for personnel health and safety is detailed in Annex III (Health and

2. Judgmental Sample Selection. Field laboratory analyses of knowledge-based (judgmental) samples can enhance the effectiveness of the investigation. Based on field laboratory analyses, additional samples having particular characteristics can be selected:

   - those with no detectable contaminants to define the edge of a plume;
   - those with the highest levels, to identify contaminants during source characterization.

3. Analytical Sample Load Reduction. Field laboratory provides the capability to relatively quickly and inexpensively assess samples for selected analytes. As a consequence, the submittal of a smaller number of samples to an off-site analytical laboratory can be justified by a base of lower quality measurements. This approach provides assurance that high quality measurements are representative and sufficient for decision making and can limit the number of samples that must be sent for more costly and time consuming analysis at an offsite analytical laboratory.

The selection of samples to be submitted to an offsite analytical laboratory, based on field laboratory results is required in this OU field investigation. The criteria to be used for making this selection depend on the focus and goals of the particular investigation, described in the SWMU-specific sampling plans (Chapter 7 of this OU work plan).

C.7.1 Radiological Measurements

C.7.1.1 Gross Alpha and Gross Beta Radioactivity

Measurements of gross alpha and beta radioactivity can be used to assess the presence of plutonium, uranium, and americium in samples, although identification of the individual radionuclides is not possible by this method. These Level II measurements can be used to guide field operations or to bias sample selection. For example, the alpha emissions from plutonium-238 are indistinguishable from those of americium-241 by gross alpha counting.

The method uses a thin-walled NaI detector in dried soil samples in a fixed geometry. A measurement time of approximately 15 to 20 min is typical. Additional detail is given in Annex II of this OU work plan and in the ER Program Generic QA Plan. The applicable SOP is:

- Screening Soil Samples for Alpha Emitters

FID. A Foxboro Model OVA-128, or its equivalent, will be used. This flame ionization detector (FID) can be used as a general screening instrument to detect the presence of many organic vapors. The instrumental response is relative to the response to a gas of known composition to which the instrument has been calibrated. The applicable SOP is:

- Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector

C.6.2.2 Combustible Gas/Oxygen Detectors

A Gastech Model 1314, or its equivalent, may be used to determine the potential for combustion or explosion of unknown atmospheres. A typical combustible gas indicator (CGI) determines the level of organic vapors and gases present in an atmosphere as a percentage of the lower explosive limit (LEL) or lower flammability limit (LFL). The Gastech Model 1314 also contains an oxygen detector to determine atmospheres that are deficient or enriched in oxygen. The applicable SOP is:

- Health and Safety Monitoring of Combustible Gas Levels

C.6.2.3 Lithologic Logging

Lithological logging of recovered core will be performed to describe the physical nature of borehole cores. Lithological logging will be performed by a geologist qualified to describe subsurface lithologies and differentiate the various strata of the Bandelier Tuff. The applicable SOP is:

- Lithological Logging of Borehole Cores

C.7 Field Laboratory Measurements

The scope and nature of field laboratory measurements to be used in support of the TA-2 and TA-41 RFI are defined in this section. The field laboratory will provide fast turn-around analysis of samples for a limited number of analytical methods. The techniques used in the field laboratory can give primarily Level I, II, or III data, as noted below. The field laboratory methods provide better quality information or lower detection limits than can be obtained with field screening or survey. In some cases, they provide a type of information that cannot be obtained with field screening or survey techniques. The intended uses of the field laboratory results are:

1. Guidance to Field Operations. The use of a field laboratory can provide fast turn-around results to aid in directing the course of field work, thus increasing the efficiency of field operations. An example is the use of field laboratory measurements to determine when to cease borehole drilling.

semivolatile organic compounds.

- Appendix IX Inorganics: The EPA standard method (SW 6010) will be used to quantify metals.
- Volatile Organics (VOAs): The EPA standard method (SW 8240) will be used to quantify volatile organic compounds.

C.9 Geohydrologic Characterization of Boreholes and Recovered Core

Methods used for geohydrologic characterization of boreholes during the TA-2 and TA-41 RFI are described in the following discussion.

C.9.1 Hydrogeologic Measurements on Recovered Core

Gravimetric water content in intact core samples will be measured quantitatively by weighing moisture loss due to oven drying by ASTM method D-4531-86 (ASTM 1946, 0743). This procedure also yields bulk density, dry density, and porosity.

Porosity (He Injection) will be measured quantitatively using intact core samples by American Petroleum Institute Method API 40, Section 3.58.

Saturated hydraulic conductivity will be measured using intact core samples by ASTM method ASTM D-2434-68 (ASTM 1946, 0743).

Air/water relative permeability will be determined by the method of van Genuchten, using data from saturated hydraulic conductivity tests and moisture characteristic curves.

C.9.2 Geochemical Measurements

Standard X-ray diffraction procedures will be applied to powdered rock and soil samples to characterize the type and relative abundance of mineral phases as follows.

- Clay mineralogy. Kaolinite, illite, and montmorillonite.
- Zeolite mineralogy.
- Matrix mineralogy. Silica polymorphs, alkali feldspars, and volcanic glass.
- Carbonate mineralogy.
- Iron and manganese mineralogy.

C.7.1.2 Gross Gamma Radioactivity

Gross gamma radioactivity will be determined by the gamma spectrometry method.

C.8 Offsite Laboratory Analysis

Subsection C.3 above, laboratory analysis levels are used in this OU work plan. Offsite laboratory analysis are intended to provide the highest quality (Level III/IV) data required. As described in above in Subsection C.2.6, samples to be submitted to an offsite analytical laboratory will be coordinated, handled, and tracked by the ER Program Sample Coordination Facility. The standard list of analytes and quantification limits is given in Annex II of this OU work plan and in the ER Program Generic QA plan. Standard commercial laboratory procedures will be modified as described in Section C.7.1 and Annex II of this OU work plan.

Some OU 1098 sampling plans rely exclusively on Level III data to support their objectives. Other plans use Level I/II data for field guidance and use the higher quality results for limited purposes. Identification of methods frequently referenced in the OU 1098 sampling plans follows:

- Gross alpha/beta and strontium-90: Analyses will be done using a gas flow proportional counter.
- Gross gamma, cesium-137, technetium-99, and cobalt-60: Radionuclides are quantified by measurement of gamma ray photon emissions in the gamma spectrometry method.
- Tritium: Tritium in water samples or in moisture distilled from soil is quantified by measuring the low energy beta emission with liquid scintillation counting.
- Total and Isotopic Uranium: Analysis will be done by the Inductiviety Coupled Plasma (ICP) method. Isotopic uranium will also be considered for analysis using alpha spectrometry.
- Isotopic Plutonium: Radiochemical methods are used to separate plutonium from soil, followed by alpha spectrometry to quantify each isotope of plutonium. Special radiochemical separation methods and counting techniques employing advanced instrumentation may be used to provide plutonium isotopic data in soil and sediment at low activity levels (Level V data).

The following analyses will be used in the TA-2 and TA-41 RFI, but are not part of the common suite of analyses in the SWMU-specific sampling plans:

- Appendix IX Organochlorine pesticides: The EPA standard method (SW 8080) will be used to quantify PCBs.
- Appendix IX Semi-volatiles Organics (SVOCs). The EPA standard method (SW 8270) will be used to quantify

REFERENCES FOR APPENDIX C

ASTM (American Society for Testing and Materials) 1946. Annual Book of ASTM Standards, Philadelphia, Pennsylvania. (ASTM 1946,0743)

Baytos, July 1991. "Field Spot-Test Kit for Explosives," Report LA-12071-MS-UC-731, Los Alamos National Laboratory, Los Alamos New Mexico. (Baytos 1991, 0741)

Donahue, D., and T. Erekian 1982. Gas Well Testing; Theory, Practice, and Regulation, International Human Resources Development Corporation, Boston, Massachusetts. (Donahue and Erekian 1982, 0405)

EPA (Environmental Protection Agency), April 1984. "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, EOA600/4-84-041, Washington, DC. (EPA 1984, 0409)

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

LANL (Los Alamos National Laboratory), May 1991. "Environmental Restoration Standard Operating Procedures," Vols. I, II, and III, Los Alamos, New Mexico. (LANL 1991, 0411)

Other geochemical measurements are as follows:

- Total organic carbon. Total organic carbon in crushed rock samples will be measured by combustion in a muffle furnace by ASTM method D-2974 (ASTM 1946).
- Cation exchange capacity. Cation ion exchange capacity will be measured on crushed core samples using EPA method 9080 (EPA 2985, 0409).

C.9.3 Environmental Isotopes Measurements

Chlorine-35/chlorine-37. This isotope ratio will be measured by accelerator mass spectrometry on chloride samples obtained by leaching crushed core samples with deionized water.

Carbon-12/carbon-13. This isotope ratio will be measured by mass spectrometry on water sample or pore water extracted under vacuum from crushed core samples.

Hydrogen/deuterium. This isotope ratio will be measured by mass spectrometry on water samples or pore water extracted from crushed core samples.

Oxygen-18/oxygen-16. This isotope will be ratio measured by mass spectrometry on water samples or pore water extracted under vacuum from crushed core samples.

Tritium. Tritium activity will be measured in water samples or pore water extracted under vacuum from crushed core samples by liquid scintillation counting methods.

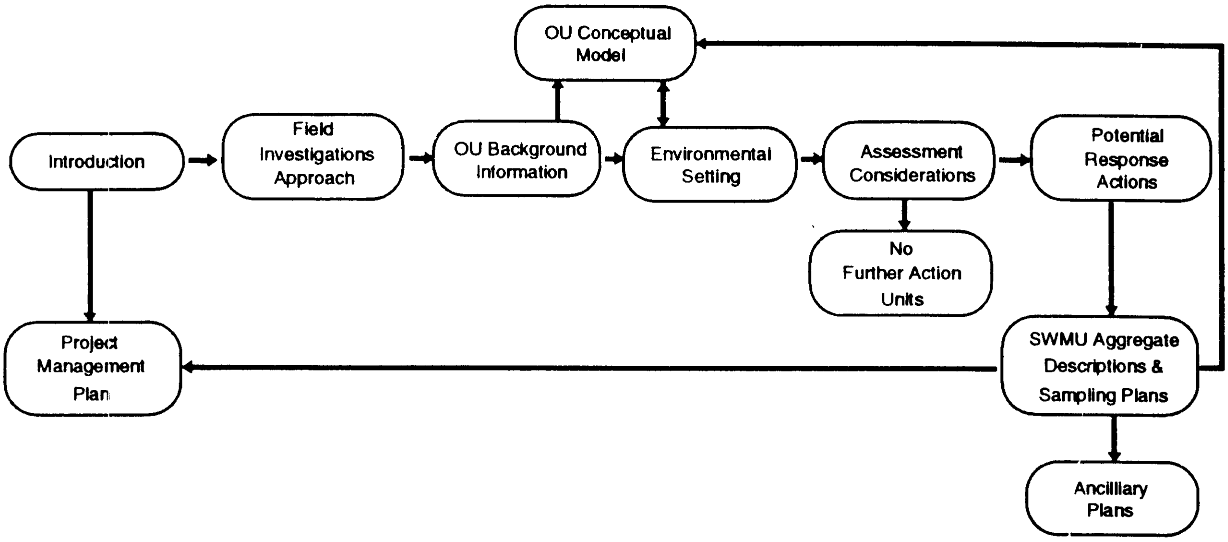
Carbon-14. Carbon-14 age determinations will be carried out by accelerator mass spectrometry on pore water extracted from crushed rock samples.

Chlorine-36. Chlorine-36 age determinations will be carried out by accelerator mass spectrometry on water samples or solutions obtained by leaching crushed core samples with deionized water.

C.9.4 Straddle Packer Tests

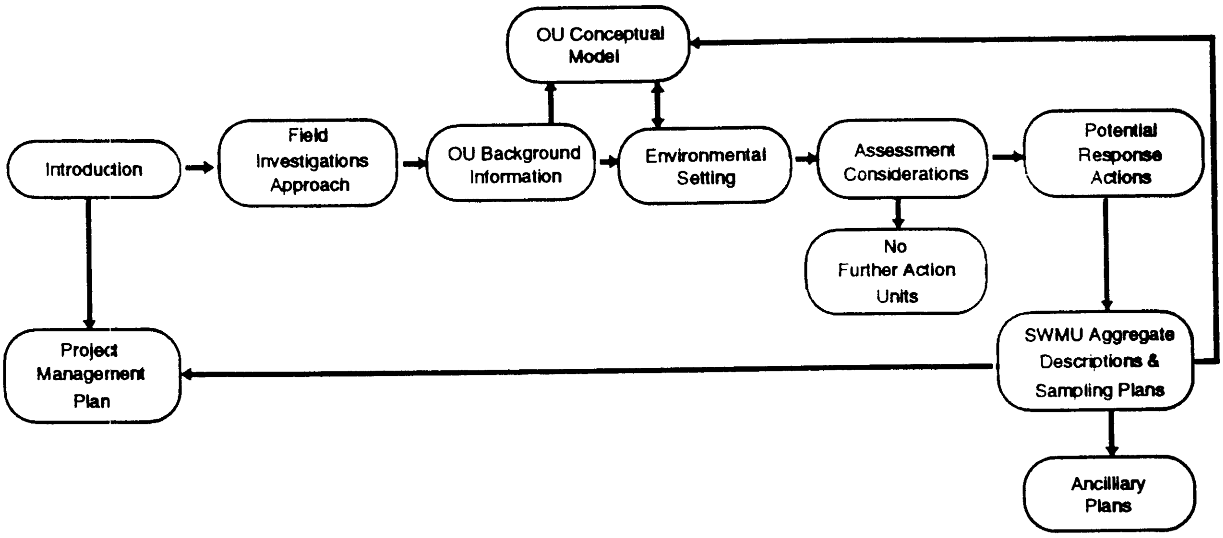
Carbon-12/carbon-13 isotope ratio will be measured by mass spectrometry methods on in situ gas samples extracted from discrete depth intervals in open boreholes.

APPENDIX D



100-yr Flood Plain Map of OU 1098

APPENDIX E



Perched Zone (Alluvial Groundwater) Monitor Well Installation

diameter). The depth to the base of the alluvial aquifer was determined by the cuttings and drilling pressure or by direct inspection of the continuous core retrieved from the hole.

The characteristics of the alluvium (hole collapse) require construction of the monitor wells through a hollow-stem auger. Accordingly, the pilot hole provided a guide for reaming the hole using a larger diameter hollow-stem auger (6.25 in. i.d., 9.625 in. o.d., with a 10.375-in. o.d. bit). This bit was run in the pilot hole with a knockout plate, and the auger joints were equipped with O-Ring seals. The hole was redrilled below the base of the aquifer.

If water was encountered in the pilot hole, it was necessary to fill the 6.25-in. i.d. hollow-stem auger with water to a level equal to the top of the aquifer to keep sands and gravels from running into the hollow stem when the plate in the bit was knocked out. The plate was knocked out and the auger raised 0.5 to 1.0 ft to anchor the casing on the bottom of the hole. The 2-in.-diameter casing was set through the hollow stem and rested on the plate. The lowest portion of the casing consisted of one or two 10-ft lengths of screen with a plug at the bottom. (In three wells, a 5-ft blank section was extended below the screen to provide for boiler descent to assist in collecting and equate sample volumes.

A premix cement (1 to 5) was used to seal part of the hole and to construct the wellhead and accompanying security cap. The cement mix came in 60-lb bags, about 0.5 ft^3 per bag. The brand name of the mixture was Quikrete, marketed by the Quikrete Company, Atlanta, Georgia 30234.

Two types of well security caps were used in completion of the monitor wells. The first type was a standard 8.625-in. o.d. steel casing set into the cement. The top of the casing was secured with a hinged plate and hasp welded to the casing. The other type of well security was the 8.625-in. o.d. steel casing set into the cement, covered by a removable "mushroom" cap made from a 13-in. steel casing about 0.5 ft long with a steel plate welded to one end. The 13-in. casing with cap was set on the 8.625-in. casing. Slots cut through the side of the cap and the casing were aligned to receive a steel bar that secures the cap to the top of the casing. A hole through the bar allows a lock to secure the cap and prevent removal of the bar. Both types of caps are shown in Figure E-1.

E.4 Well Development

Well development was carried out using several techniques in combination. However, none of the monitor wells that have water in them have yet been able to meet the turbidity requirement of 5 nephelometric turbidity units. This was as expected, based on previous experience with the 25- to 30-year-old U.S. Geological Survey monitor wells, which still yield samples with considerable turbidity. The turbidity results from the fine suspended clays and silts found in the aquifer. These clays and silts are derived from weathering of the ash matrix of the tuff. As a result, the smallest size screen generally available from commercial sources (0.010 in.), with matched sand size (0.010 to 0.020 in.), was used in completing all the new wells. The presence of these suspended sediments and the fluctuation of the thickness of the aquifer have hampered or prevented well development, even without suspended sediments entering the wells during bailing.

APPENDIX E PERCHED ZONE (ALLUVIAL GROUNDWATER) MONITOR WELL INSTALLATION

E.1 Introduction

The Hazardous Waste Permit (Hazardous and Solid Waste Amendments, 1984) issued to the United States Department of Energy (owner) and the University of California (operator) contains several Special Conditions in Module VIII, Sec. C. The first condition relates to Perched Zone Monitoring. This condition required the installation of five additional monitor wells or borings in Los Alamos Canyon. These new monitor wells include LAO-3A, LAO-4.5A, LAO-4.5B, LAO-4.5C, and LAO-6A, and are located near LAO-3, LAO-4.5, and LAO-5. Older monitor wells include LAO-C, LAO-1, LAO-2, LAO-3, LAO-4, and LAO 4.5.

Los Alamos Canyon was created by an east-trending perennial to intermittent stream that has cut deeply into the surface of the Pajarito Plateau. The stream flow has eroded, transported, and deposited alluvium in the stream channel of Los Alamos Canyon. The origin of the drainage area of the canyon heads on the flanks of the Jemez Mountains west of the plateau and consists mainly sands, gravels, cobbles, and boulders derived from dense volcanic rocks.

The shallow alluvial aquifer of Los Alamos Canyon is characterized by sands, gravels, cobbles, and boulders. This aquifer exists as zones of saturation along the canyon bottom and is perched on the underlying Otowi Member of the Bandelier Tuff. The aquifer is of limited horizontal extent and is dependent on surface water for recharge. Spring snowmelt run-off causes water levels in the aquifer to rise and the aquifer to advance down the canyon. In early summer, the water levels typically decline and the aquifers retreat up the canyon. Summer run-off causes the water levels to rise and the alluvial aquifer to advance down the canyon; the lack of run-off in the fall and winter causes the water levels to decline and the aquifer to retreat up the canyon. These same hydrologic effects result from treated industrial and/or sanitary effluents from TA-2 and TA-41. Thus, depending on the amount of recharge, the saturated thickness of the aquifer will vary.

E.2 Well Drilling and Completion

Monitor wells LAO-3A, LAO-4.5A, LAO-4.5B, LAO-4.5C, and LAO-6A were drilled and completed using the same basic equipment and methods. The methods generally followed the recommendations of the Resource Conservation and Recovery Act (RCRA) Ground-Water Monitoring Technical Enforcement Guidance Document (TEGD) to the extent practicable and allowing for some modifications based on more than 40 years of experience with monitoring initiated by the U.S. Geological Survey. These methods are described in this section and are applicable to these new wells. Details of each individual well completion are provided in individual figures discussed later in this appendix. A pilot hole was drilled with either a standard continuous-flight auger (4.5 in. diameter) or cored with a hollow-stem auger (7.25-in. hole

The monitor wells were developed using a surge block, pumping, bailing, and jetting. At least two methods were used in each monitor well. The choice of methods depended on the depth to water and observations of the saturated thickness. Jetting was the most commonly used method and was applied to all of the Los Alamos Canyon monitor wells.

E.5 Monitor Wells

The monitor well elevations, measuring points (MPs), and coordinates (New Mexico State Plane system) are shown in Table E-I. Well characteristics are presented in Table E-II. The log, casing schedule, and construction details for each well are found in Figures E-2 through E-14. Locations of the observation wells and holes are indicated in Figures 4.4-2. Alluvial groundwater exists in most of Los Alamos Canyon where surface stream flow occurs throughout the year.

E.6 Los Alamos Canyon

Los Alamos Canyon monitor well LAO-3A was completed in alluvium underlain by tuff. Groundwater was perched on the weathered tuff (Figure E-6).

Three monitor wells were completed near LAO-4.5. Two of the monitor wells were dry but were completed as monitor wells because there is a possibility of the alluvium or sand lenses in the underlying siltstone and claystone becoming saturated during storm run-off events (Figures E-8, E-9, and E-10). The siltstone and claystone underlying the alluvium is associated with the basalt that underlies the alluvium to the east. Water occurs in sand lenses within the siltstone and claystone.

Los Alamos Canyon monitor well LAO-6A was completed through the alluvium into the top of a basalt flow (Figure E-14). The monitor well contained water when completed but went dry during the summer as the aquifer retreated up the canyon.

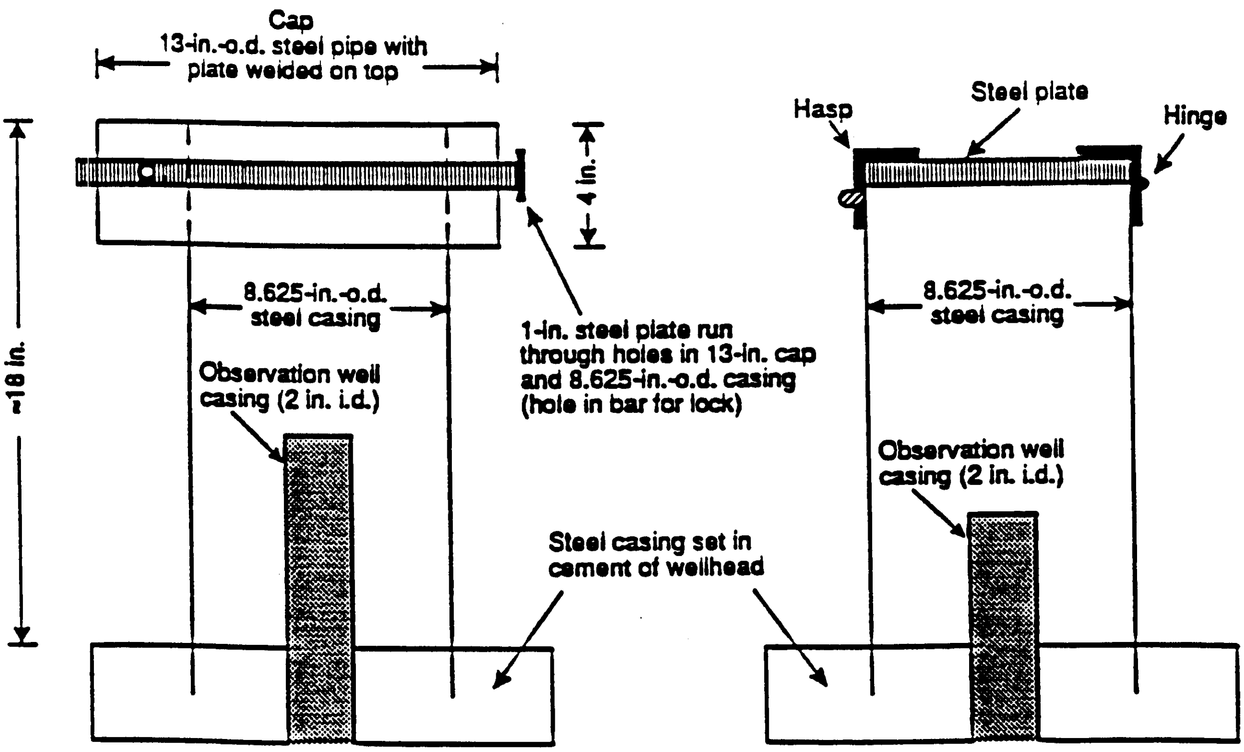


Figure E-1 Two types of wellhead security locks used on canyon observation wells.

Table E-II. Well Characteristics and Water Levels

	Date Drilled	Date Completed	Depth Drilled (ft)	Depth Completed (ft)	Water Levels Below Land Surface Datum (ft)			
					Date	Water Level	Date	Water Level
LAO-3A	9-14-89	9-14-89	18	14.7	9-14-89	6.7	6-21-90	5.5
LAO-4.5A	9-13-89	9-14-89	20	18.5	9-14-89	Dry	6-21-90	Dry
LAO-4.5B	9-15-89	9-16-89	35	34.9	9-16-90	Dry	6-21-90	Dry
LAO-4.5C	11-21-89	11-22-89	25	23.3	11-22-89	10.6	6-21-90	10.7
LAO-6A	8-17-89	8-17-89	15	14.2	8-17-89	9.0	6-21-90	Dry

Table E-I. Observation Well Elevations and Measuring Point

	Top of Steel Casing (ft above sea level)	PVC Casing Measuring Point (ft above sea level)	Land Surface Datum, or Brass Cap (ft above sea level)	Measuring Point to Land Surface Datum	New Mexico State Plane Coordinates (Brass Cap) Northing	Easting
LAO-3A	6580.38	6579.83	6579.40	-0.43	1 773 037.645	497 736.545
LAO-4.5A	6461.58	6460.38	6459.89	-0.49	1 771 989.595	503 255.968
LAO-4.5B	6461.76	6460.59	6459.37	-1.22	1 771 992.471	503 303.058
LAO-4.5C	6459.23	6458.72	6457.63	-1.11	1 772 014.413	503 303.058
LAO-6A	6396.73	6396.26	6395.88	-0.38	1 771 281.902	505 977.349
LAO-C	7049.98					
LAO-1	6836.24					
LAO-2	6592.97					
LAO-3	6578.10					
LAO4	6518.73					
LAO-4.5	6451.75					

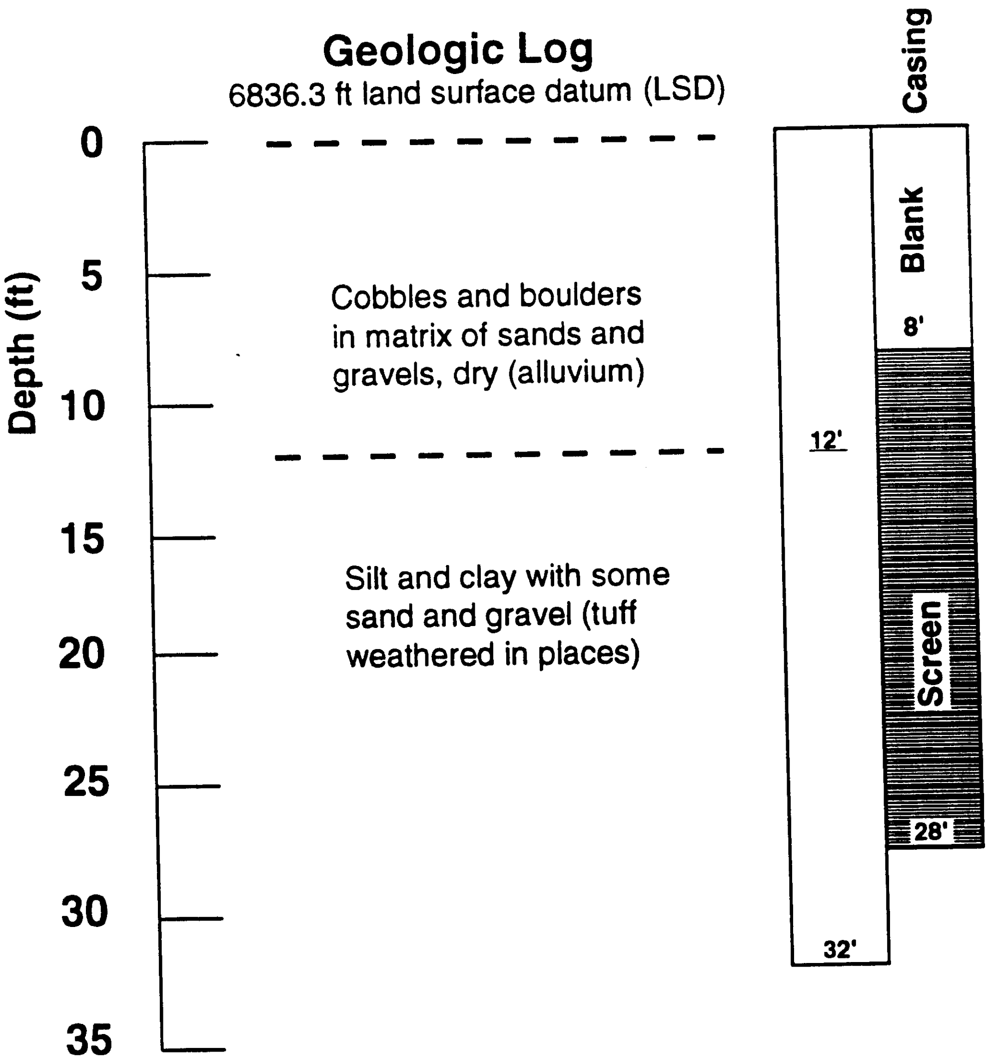


Figure E-3 Los Alamos Canyon observation well LAO- 1 (completed February 1966, water level 4.6 ft).

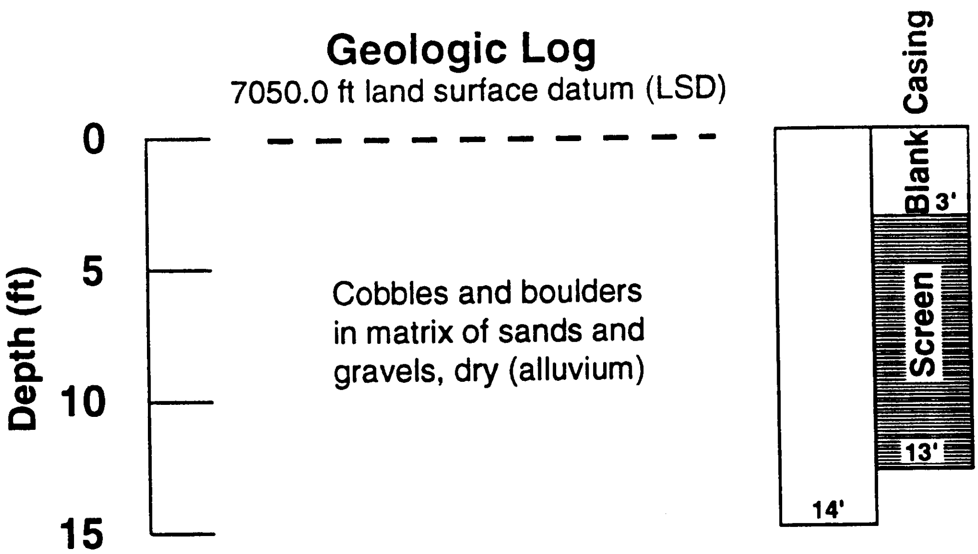


Figure E-2 Los Alamos Canyon observation well LAO- C (completed August 1970, water level 2.5 ft).

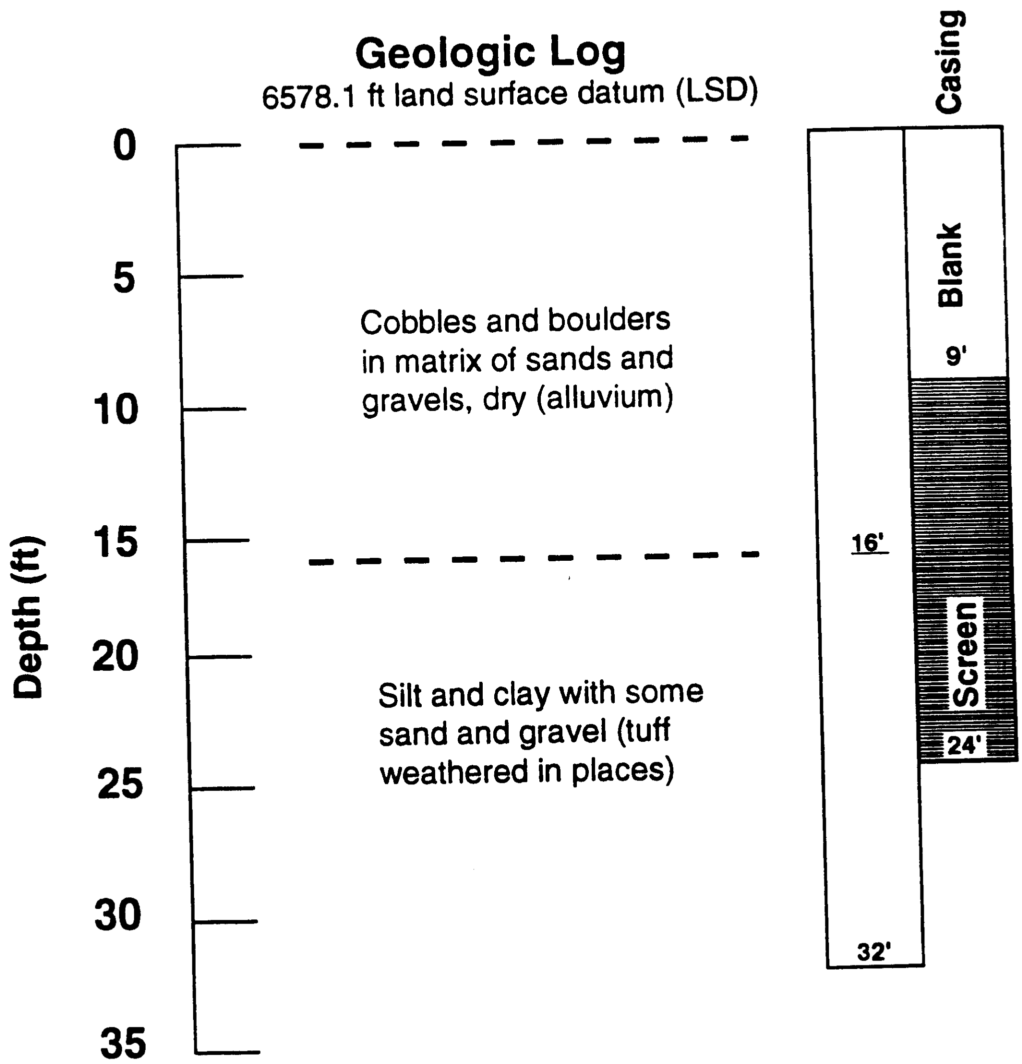


Figure E-5 Los Alamos Canyon observation well LAO- 3 (completed February 1966, water level 6.5 ft).

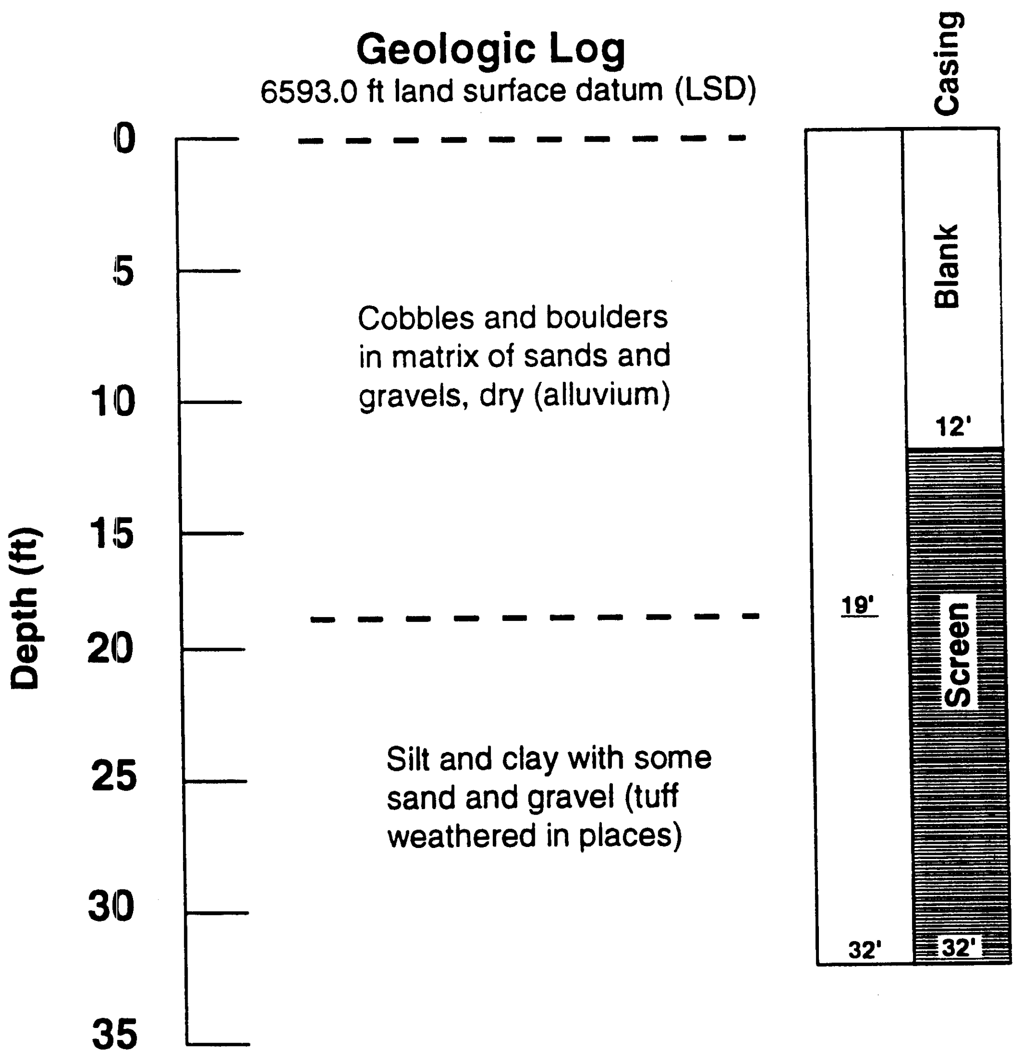


Figure E-4 Los Alamos Canyon observation well LAO- 2 (completed February 1966, water level 11.0 ft).

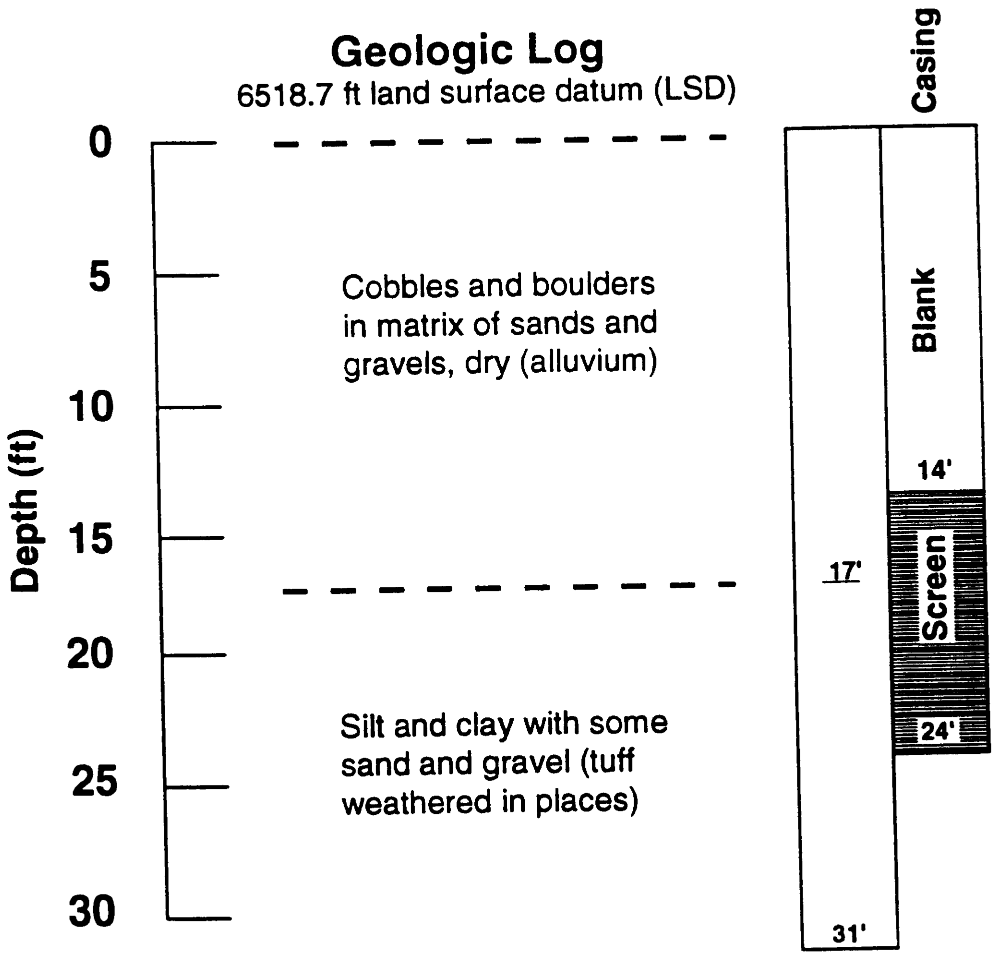


Figure E-7 Los Alamos Canyon observation well LAO-4 (completed February 1966, water level 12.6 ft).

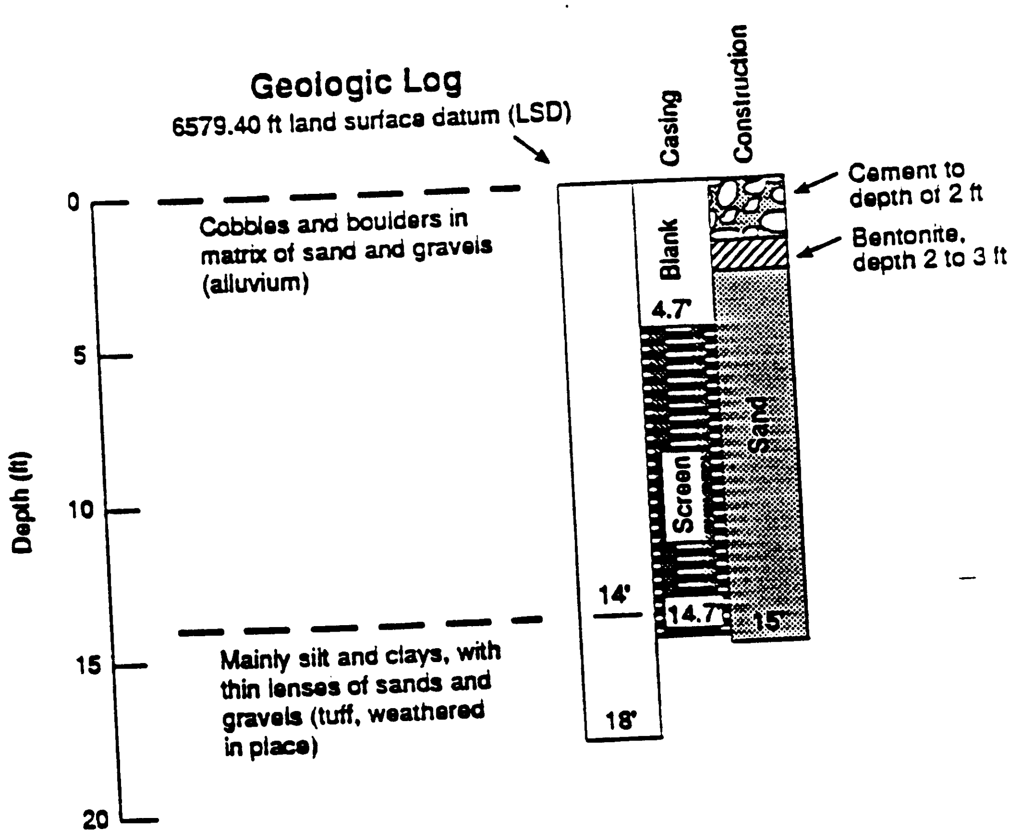


Figure E-6 Los Alamos Canyon observation well LAO-3A (completed September 14,1989, water level 7 ft).

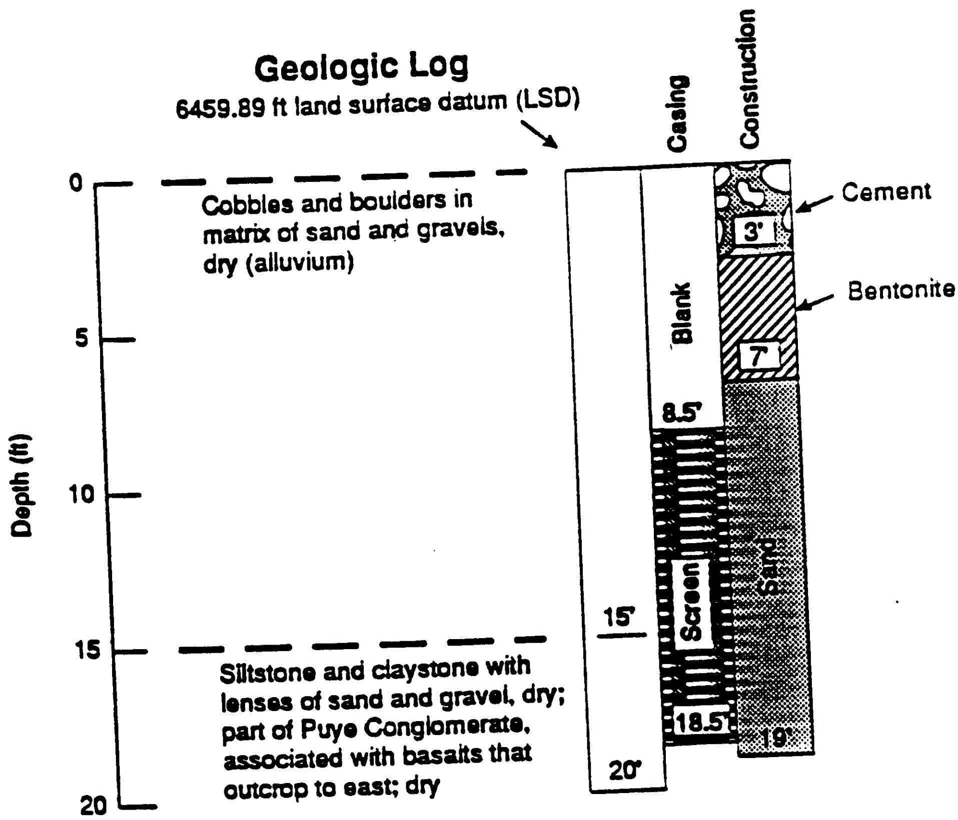


Figure E-9 Los Alamos Canyon observation well LAO-4.5A (completed September 14,1989, dry).

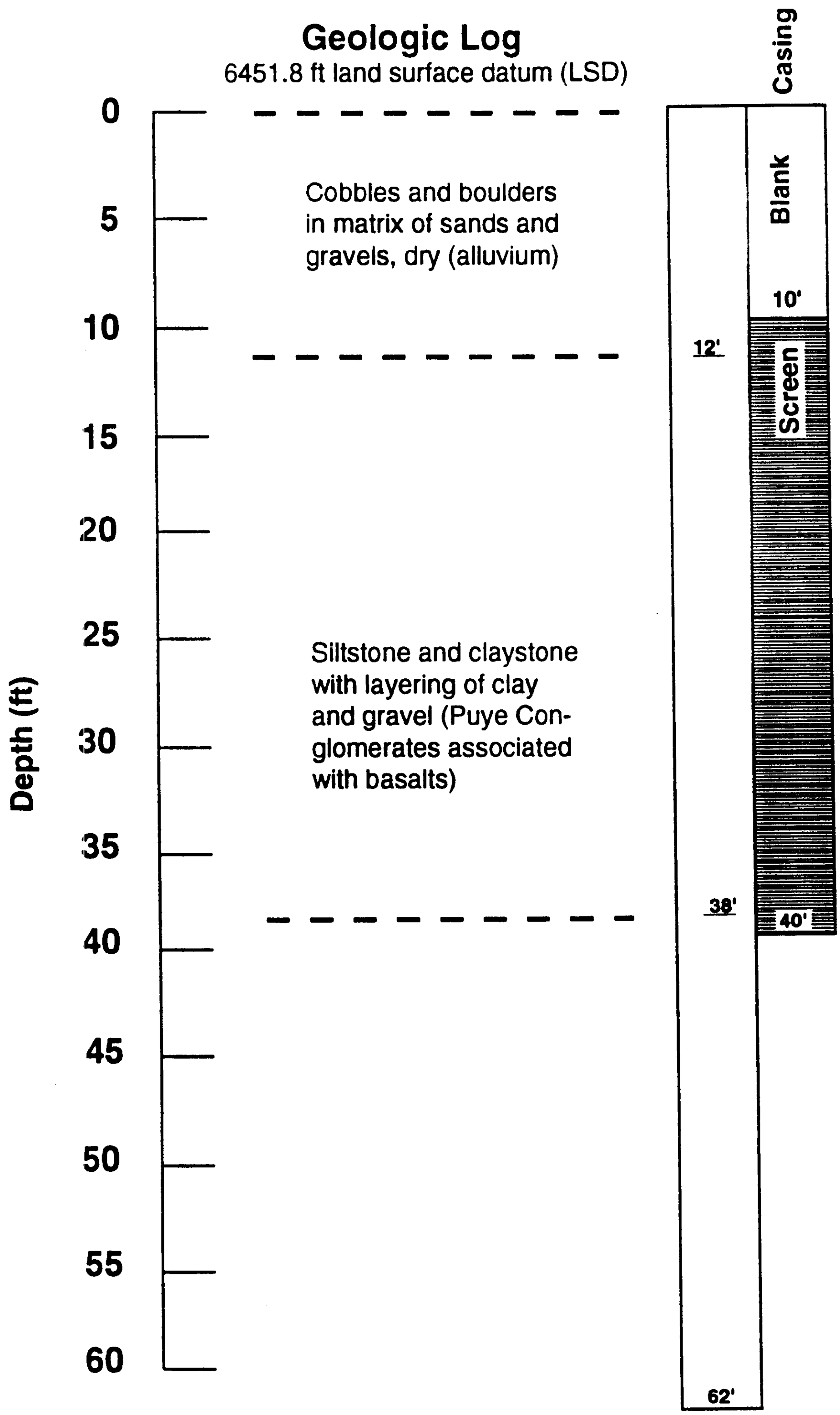


Figure E-8 Los Alamos Canyon observation well LAO- 4.5 (completed April 1969, water level 4.5 ft).

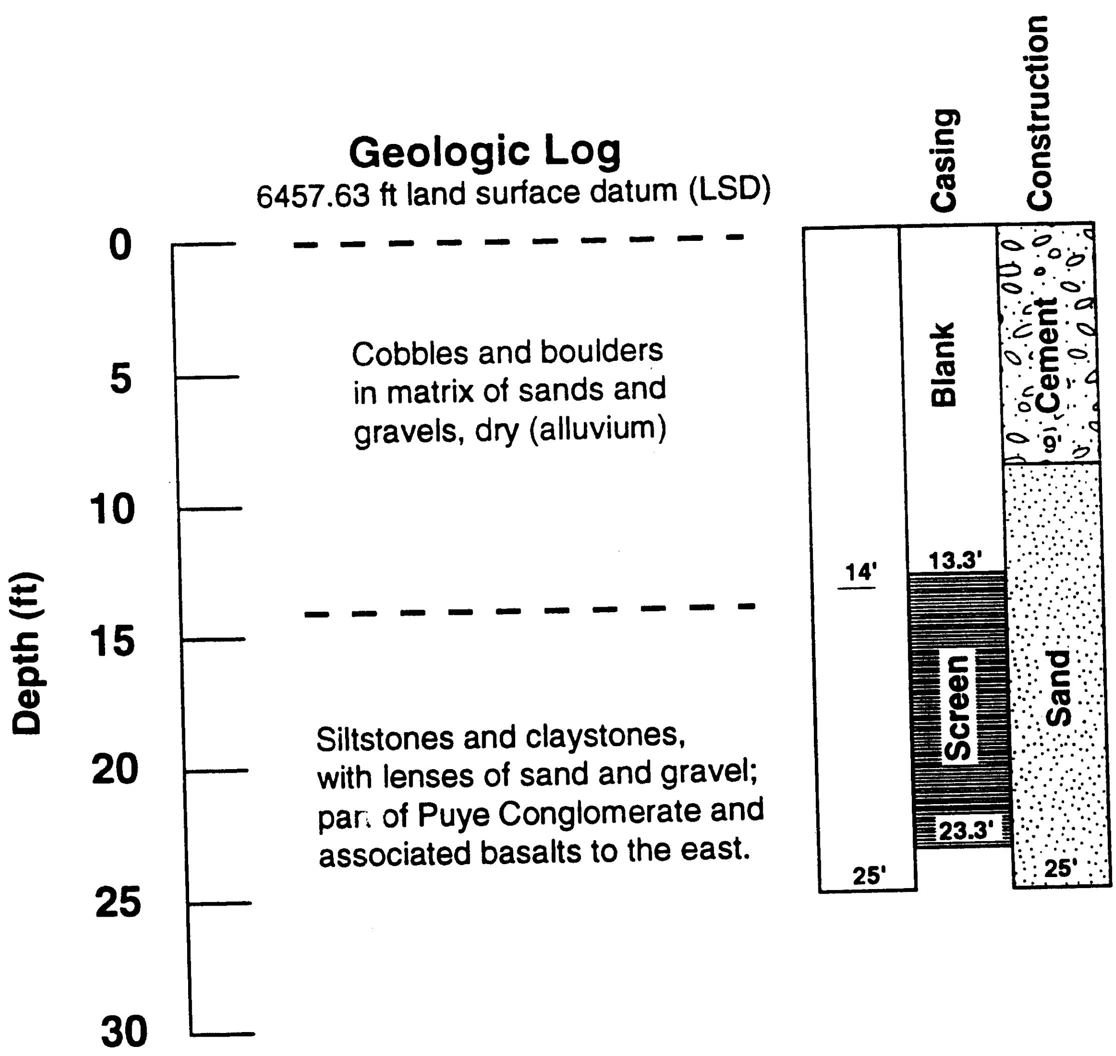


Figure E-11 Los Alamos Canyon observation well LAO-4.5C (completed November 22, 1989, water level 11 ft).

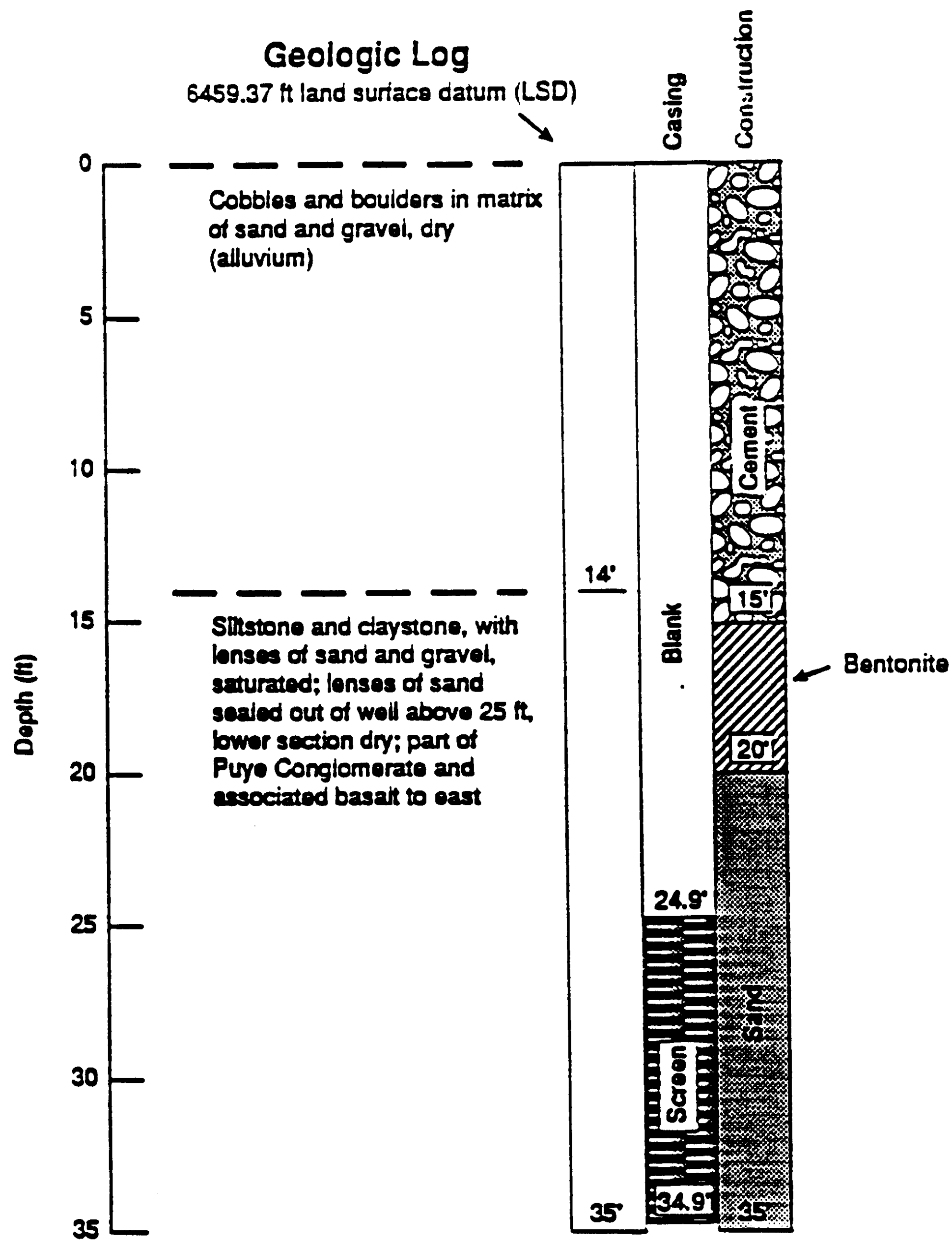


Figure E-10 Los Alamos Canyon observation well LAO-4.5B (completed September 16,1989, dry).

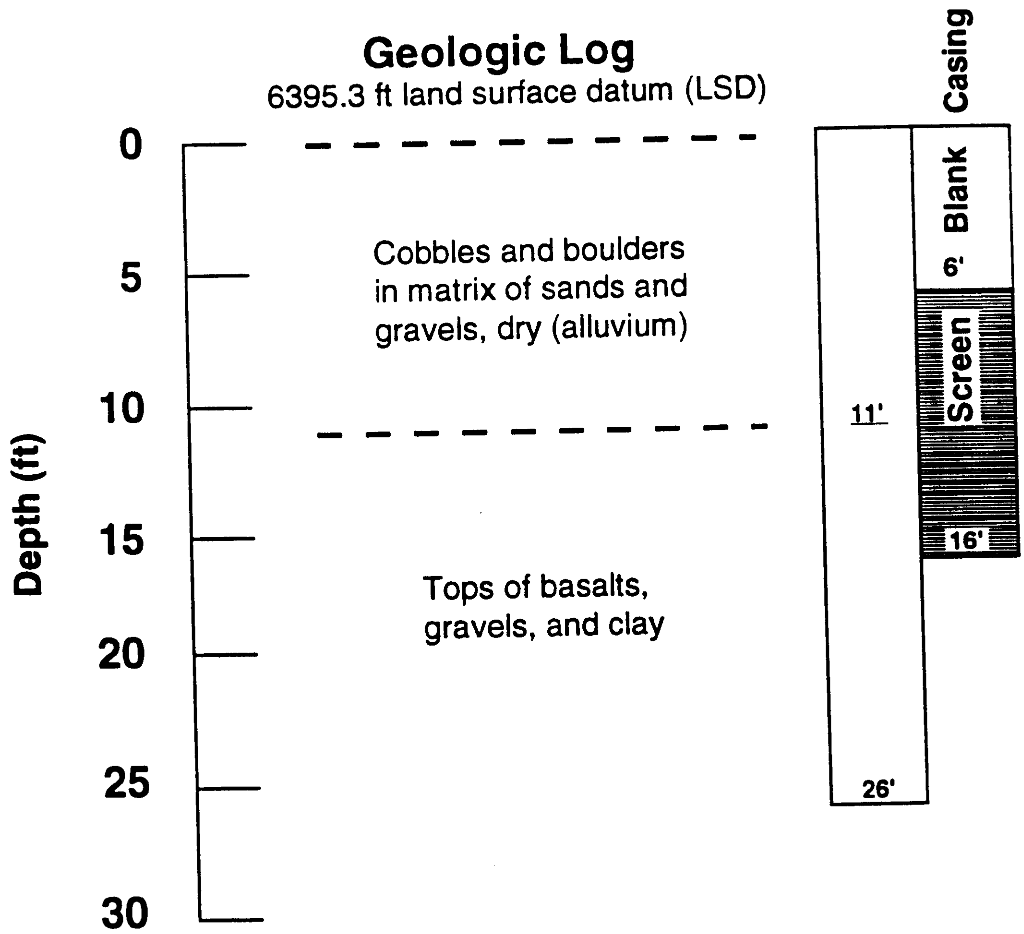


Figure E-13 Los Alamos Canyon observation well LAO- 6 (completed February 1966, Dry).

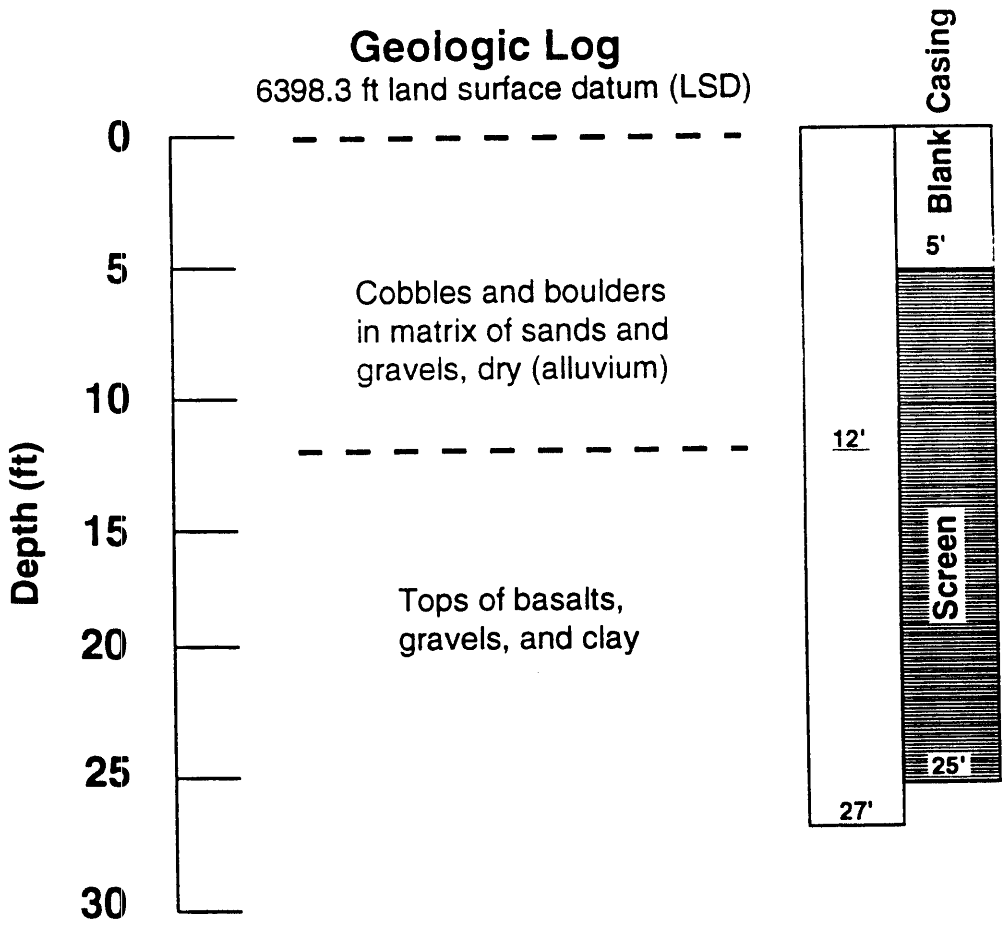


Figure E-12 Los Alamos Canyon observation well LAO-5 (completed February 1966, Dry).

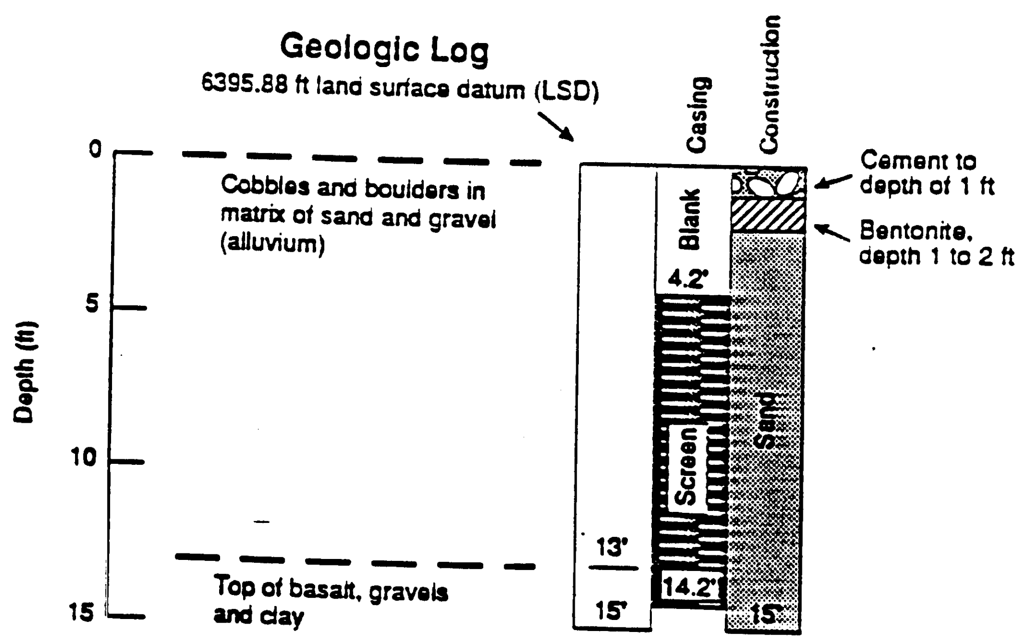
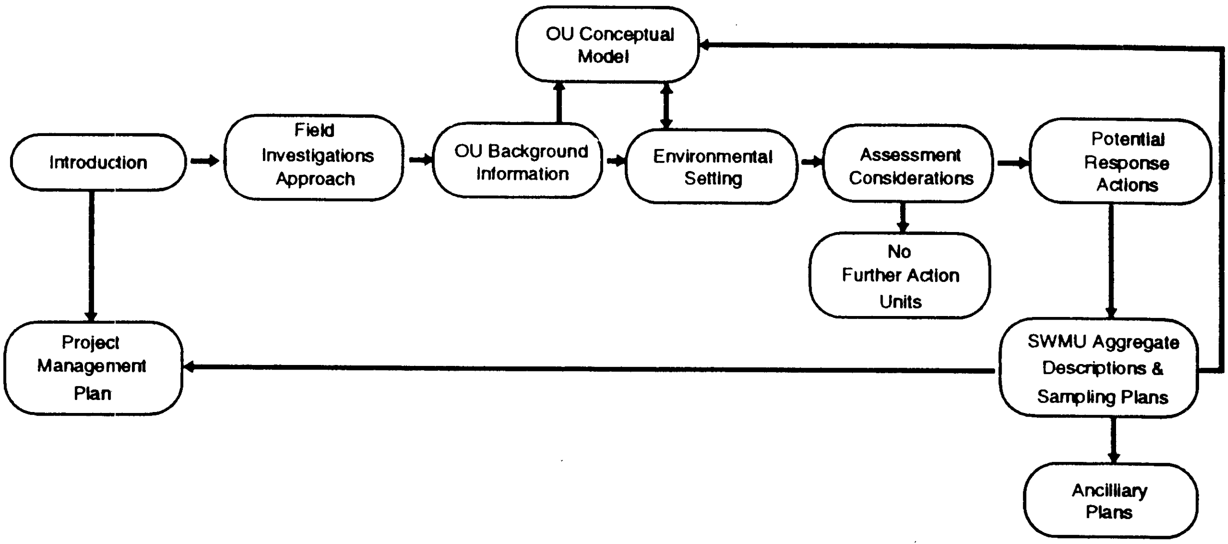


Figure E-14 Los Alamos Canyon observation well LAO-6A (completed August 17,1989, water level 9.0 ft).

APPENDIX F



Radiological Survey Methods

available. Surveys typically are conducted by carrying the instruments close to the ground surface, or attaching the instruments to tripods, and observing the ratemeter or scalar. Also, measurements may be made at the ground surface to indentify and precisely locate highly localized contamination. The applicable SOPs are:

- Near Surface and Soil Sample Screening for Low-Energy Gamma Radiation using the FIDLER
- Near Surface and Soil Sample Screening for Low-Energy Gamma Radiation using the PHOSWICH

F.4 Gamma Spectrometry Systems

The Energy Measurements Division of EG&G-Las Vegas operates the Department of Energy's Remote Sensing Laboratory. This laboratory maintains state of the art ground- and airborne-vehicle based gamma spectrometry systems which have been valuable duriong a number of environmental studies involving radioactive contamination at DOE, DOD, and other sites (see Table F.4-1). Figure F.4-1 contains photographs of typical tripod-mounted and ground-vehicle based *in situ* systems used in a recent radiological survey of surface soils at the DOE's Rocky Flats Plant.

Ground-based (*in situ*) gamma spectrometry systems (shown in Figure F.4-1) use liquid nitrogen-cooled high purity germanium (HPGe) detectors mounted on an easily-moved tripod, or on a retractable arm attached to a four-wheel drive vehicle. The retractable arm on the vehicle-based system allows the detector's height above ground to be varied from essentially ground level to about ten meters. A height of about 7.5 meters typically is used, and lead collimators can be used to vary the cone angle available to the detector's sensor.

The vehicle also contains a computer processing facility so raw data processing and preliminary contamination mapping can be performed in real time in the field. Subsequent refinement of the data occurs offsite resulting in a map of individual radionuclides (or groups of radionuclides emitting gamma rays of similar energy). Airborne gamma spectrometry systems differ from ground-based systems because they use arrays of sensitive detectors.

Minimum detectable activities (MDA) for several radionuclides of interest for the TA-2 and TA-41 OU are listed in Table F.4-2. Minimum detectable activities are listed for both ground-based (*in situ*) and aerial-based systems. Because gamma-rays are strongly attenuated by solid matter, gamma survey methods are useful only for the uppermost portion of the soil horizon. For example, for the 60 keV emission characterizing americium-241, for a uniform distribution with depth, approximately 95% of the unscattered gamma rays reaching the detector would originate within the top 6 cm of the soil and approximately 99% would originate within the top 9 cm.

APPENDIX F - RADIOLOGICAL SURVEY METHODS

F.1 Introduction

Radiological field surveys are primarily scans of the land surface using direct reading or recording instruments. For the TA-2 and TA-41 OU work plan, radiological surveys are used to identify and refine locations where contamination above screening levels may exist. While negative field survey results are not necessarily conclusive evidence for the absence of elevated levels of radioactive contaminants, the probability that such contamination exists can be minimized with the proper design and execution of radiological surveys. When elevated contamination levels are detected, survey equipment allows the precise location of hot spots to be determined for subsequent discrete soil sampling.

Radiological surveys to detect surface contamination are exceptionally convenient and rapid to carry out. Survey methods have the disadvantage that the x-ray and gamma-ray signatures are strongly attenuated by solid matter, and therefore contamination below the surface (in most cases, depths greater than 1-2 in.) are not detected reliably. A second disadvantage is that minimum detection limits are highly isotope specific, depending upon the nuclear characteristics of the decaying isotope.

F.2 Gross Gamma Surveys

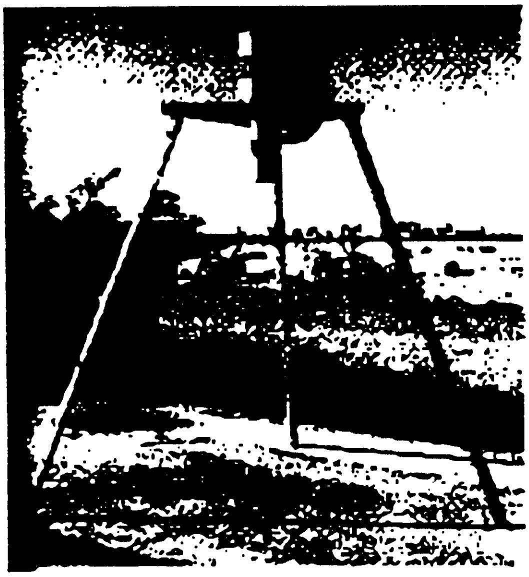
Several instruments available that are suitable for gamma surveys include: micro-R meters, NaI detectors of various sizes (with ratemeters and scalers), and Geiger-Mueller detectors. The preferred instruments are micro-R meters with the ability to measure 5μR/hr, and 2-in. by 2-in. NaI detectors with a ratemeter capable of displaying 100 cpm. Some discrete-measurement or continuous-measurement instruments also are available using the same detectors. Surveys typically are conducted by carrying these instruments at waist height at a slow walking pace and observing and recording the ratemeter response. Measurement also may be made at the ground surface to aid in identifying the presence of localized contamination. The applicable LANL ER SOP is

- Measurement of Gamma Radiation Using a Sodium Iodide (NaI) Detector

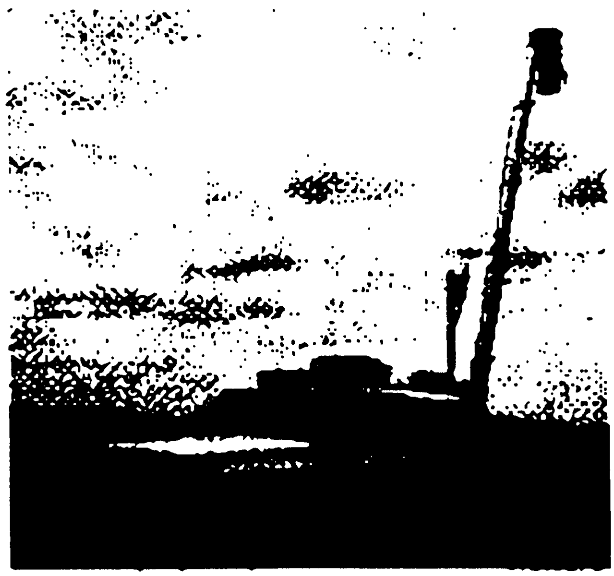
F.3 Low-Energy Gamma Surveys

FIDLER and PHOSWICH instruments are most commonly used to detect radionuclides which emit low-energy gamma and x-ray radiation. Both instruments are optimized to detect low-energy photons, such as the 60 keV gamma emission from americium-241 or the x-rays that accompany the decay of most heavy radionuclides including uranium, plutonium, and other transuranics. Discrete- or continuous-measurement recording options are

Figure F.4-1. Photographs of *in situ* gamma spectrometry systems operated by the Remote Sensing Laboratory. Photographs are from EG&G (Tipton et al. 1981, 0695).



Tripod Based Sampling System



Surburban Sampling System

Table F.4-2. Typical minimum detectable activities (MDAs) for surface soils using the Remote Sensing Laboratory's *in situ* and helicopter-based gamma spectrometry systems.[1]

ISOTOPE	HELICOPTER[2] μCi/m²	*IN SITU*[3] μCi/m²
Am^{241}	0.1	0.006
Pu^{239}	400	30
U^{235}	0.03	0.003
U^{238}	1.0	0.04
Cs^{137}	0.02	0.002
I^{131}	0.02	0.002
Co^{60}	0.01	0.001

1) An infinite (uniform) surface distribution of radionuclides is assumed. MDAs are from the EG&G reports cited in the reference list. Actual values can vary by a factor of two or more at specific sites, depending upon background.

2) Altitude 30 m, speed 60 knots, 20 NaI(Tl) detectors (12.7 cm x 5.1 cm), 1 second acquisition time.

3) Height 1 m, 20% n-Type High Purity Germanium Detector, 10 min. acquisition time.

Table F.4-1. Past environmental applications of the Remote Sensing Laboratory's gamma spectrometry systems.

SITE	SURVEY LOCATION	DATE	ISOTOPES OF INTEREST	APPLICATION
Enewetak Atoll	Western Pacific	7/77-12/79	Am^{241}	Cleanup
Gnome	Carlsbad, New Mexico	8/77-9/77	Cs^{137}	Assessment
Johnston Atoll	Western Pacific	4/80-8/80	Am^{241}	Mapping
Middlesex Plant	Middlesex, New Jersey	7/80-11/80	Ra^{226}	Cleanup
Kellex	Jersey City, New Jersey	9/80-11/80	$U^{235,238}$ Th^{232}	Assessment
Area 11	Nevada Test Site	6/81-9/81	Am^{241}	Cleanup
Areas 2, 15, and 21	Los Alamos Natl. Lab.	9/82	Am^{241} Cs^{137}, U^{238}	Mapping
Areas 1-13, 15-20, 25, 26 and 30	Nevada Test Site	6/81-3/86	All measurable	Mapping/ Inventory
Maralinga	South Australia	5/87-7/87	Am^{241}, Cs^{137}, U^{238}	Survey support
Rocky Flats Plant	Golden, Colorado	12/90	Am^{241}, $U^{235,238}$	Assessment

Figure F.4-2. Typical MDAs and distributed source MDA curve for Rocky Flats buffer zone surface soils. Data are from the report on the *in situ* survey of Rocky Flats (Reiman 1991, 0722).

ISOTOPE	MDA (pCi/g)
Am^{241}	0.9
Cs^{137}	0.1
U^{238}	4.1
Ra^{226}	0.2
Th^{232}	0.2
K^{40}	0.2

MDA = Minimum Detectable Activity = A/B where

A = Activity read on graph (pCi/g) for B=1

B = Branching rates (gamma/disintegration)

For:
- three standard deviation statistical uncertainty of typical background spectrum
- 15 minute acquisition time
- 20 % Bare N-type HPGe detector
- 7.5 meter detector elevation
- 46 meter grid
- uniform distribution averaged over top 3 cm

Minimum detectable activities also are strongly isotope dependent, as indicated in Table F.4-2. Isotope dependency is due both to the energy of the emission (lower energies are more strongly attenuated and give lower detector response) and the branching factor (fraction of radioactive decays which give rise to gamma ray emission). Of particular relevance to the investigation for the TA-2 and TA-41 OU is the relatively low sensitivity to plutonium emissions, primarily due to the low branching factor. However, sensitivity is excellent to cesium-137, uranium-235 and -238, and americium-241 (the daughter product of the relatively short lived isotope plutonium-241). All of these are important contaminants of concern at the TA-2 and TA-41 OU. The spectrometer system can be optimized for specific isotopes of interest in the survey.

The usual approach for deducing plutonium distributions from gamma-ray techniques is to measure the easily-detected signature from americium-241 and to apply a factor accounting for the americium/plutonium ratio at the site. This approach assumes that the ratio does not vary over the site due to either partitioning of americium and plutonium by environmental processes or the existence of plutonium at various ages and initial isotopic mixtures.

Fractionation of americium and plutonium in the environment has rarely been observed, and past studies generally have shown the process to be negligible at arid or semiarid sites such as TA-2 and TA-41 . In addition, the plutonium and americium source history at TA-2 and TA-41 is unusually well defined. Therefore, the TA-2 and TA-41 OU is especially well suited to use americium surface survey results to deduce plutonium levels. In any case, the plutonium/americium levels will be measured at all TA-2 and TA-41 SWMUs from discrete sampling to confirm that the americium/plutonium is adequately well known and the ratio is invariant across the OU.

Results from radiological surveys usually are expressed in units of $\mu Ci/m^2$. Conversion to units of pCi/g requires some knowledge or assumptions about the vertical and lateral distribution of the radionuclide in the soil.

Source term size also has a strong impact on lower detection limits. Table F.4-3 and Figure F.4-2 give some conversion factors and illustrate the lower sensitivity for point versus uniformly distributed sources. For example, consider a typical *in situ* system configuration with a detector height of 7.4 m and a corresponding field of view of about 300 m^2 (20 m diameter). For a uniform surface distribution of americium-241, the minimum detectable activity (MDA) is about 11 pCi/g, or 0.36 mCi for a point source. This sensitivity is comparable to, or better than, that of FIDLER or PHOSWICH systems (not radionuclide-specific) operating at a height of about one meter above land surface, with a corresponding survey area of several square meters.

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Boyns, P.K., May 1990. "An Aerial Radiological Survey of the United States Department of Energy's Rocky Flats Plant and Surrounding Area, Golden, Colorado," EGG-10617-1044, EG&G Energy Measurements, Golden, Colorado. (Boyns 1990, 0696)

Reiman, R. T., May 1991. "*In Situ* Surveys of the United States Department of Energy's Rocky Flats Plant, Golden, Colorado," EGG-10617-1129, EG&G Energy Measurements, Golden, Colorado. (Reiman 1991, 0722)

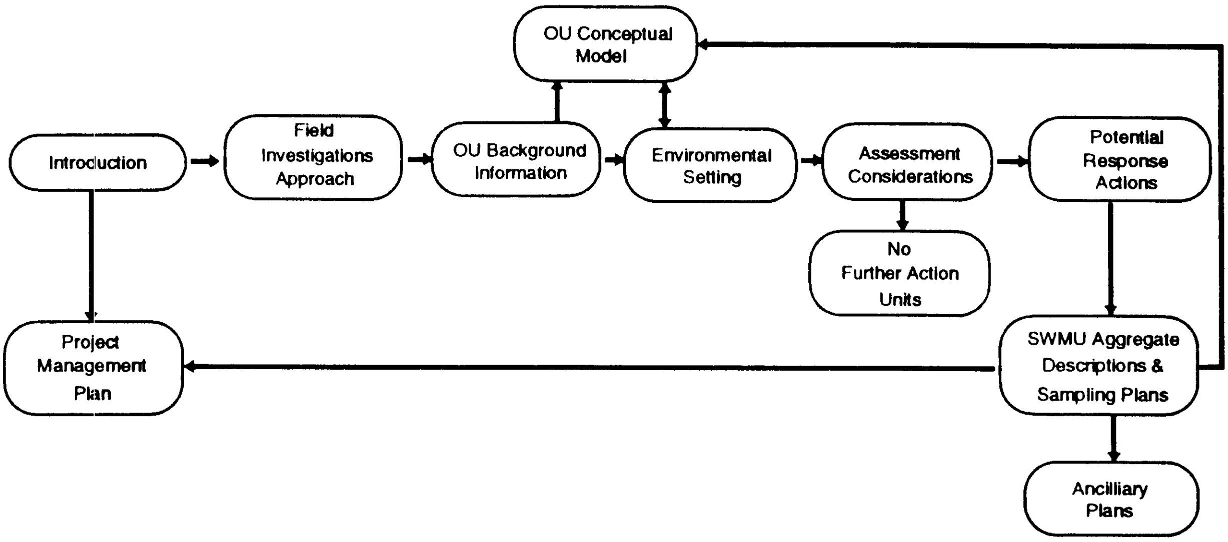
Tipton, W. J., A. E. Fritzsche, R. J. Jaffe, and A. E. Villaire, November 1981. "An *In Situ* Determination of 241 Am on Enewetok Atoll," EGG-1183, 1778, EG&G Energy Measurements Group, Golden, Colorado. (Tipton et al. 1981, 0695)

Table F.4-3. Geometric factors influencing minimum detectable activities. Data are from the report on the aerial radiological survey of the Rocky Flats Plant (Boyns 1990, 0696).

Finite Am-241 Source Correction Factors Versus Area of Contamination	
Source Diameter (meters)	**Correction Factor**
10	37
20	9
40	3.5
60	2.2
80	1.6
100	1.3
140	1.1
>140	1.0

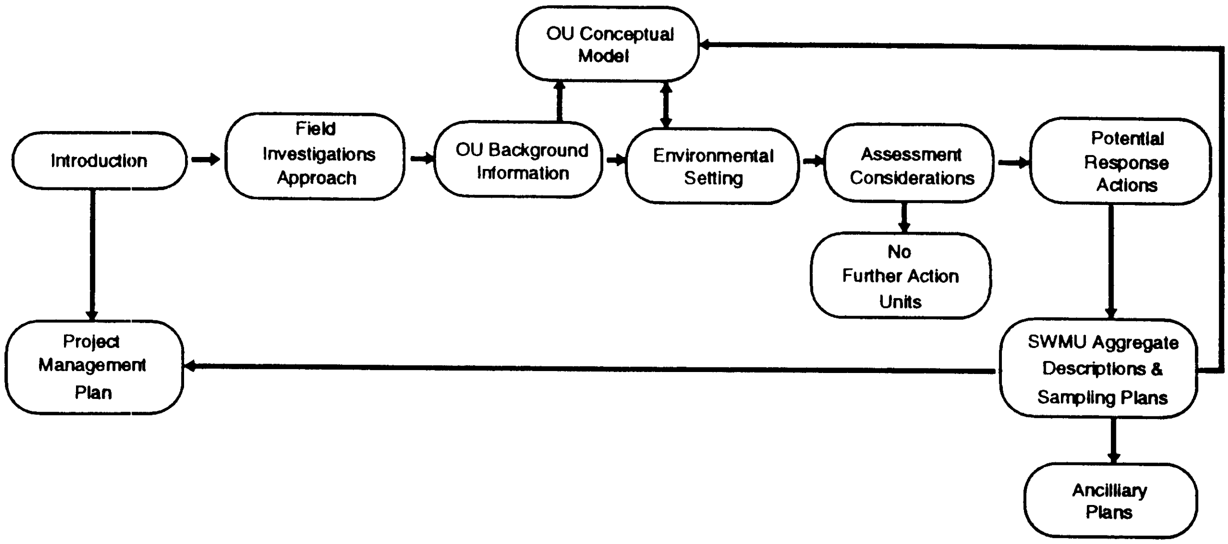
Correction Factors Versus Area of Contamination	
Diameter of Contaminated Circular Area (meters)	**Correction Factor**
5	300
10	100
25	10
50	6.5
100	2.5
200	1.2
300	1.0
oo	1.0

APPENDIX G



Utility Map of Los Alamos Canyon

APPENDIX H



TA-2 and TA-41 Operable Unit Work Plan Contributors: Education and Relevant Experience

Robert Vocke, EM-13	Ph.D. Water Resources * 16 years experience in hazardous waste site assessment, including waste management, regulatory compliance, and program management.	ER Program Manager; EM-13 Group Leader
Kevin J. Walter, ERM/Golder	M. Eng. Environmental Engineering *18 years of experience in site investigation/ remediation engineering and management; extensive knowledge of federal compliance programs, surface water quality issues, NPDES permitting.	ER support contractor - ERM Program Management; technical coordinator

II. TECHNICAL CONTRIBUTORS

NAME AND AFFILIATION	EDUCATION/EXPERTISE	TA-2 and TA-41 OU ASSIGNMENT
Kathryn D. Bennett, EM-8	M.S. Environmental Science * 3 years experience in NEPA biological activities including Laboratory wetlands evaluation, endangered/threatened species studies, and environmental database development.	NEPA biological evaluation
Paula M. Bertino, ERM/Golder	M.A. International Studies (Energy Management) *10 years of experience in program development and implementation of regulatory compliance audits and property assessments.	ER support contractor - ERM, Program Management sampling design, data quality objectives, TA-1 input
Rebecca Brown, ERM /Golder	M.S. Geology *1 year of experience in investigating aspects of geochemistry and transport of barium in soils and tuffs and assisting the Remedial Investigation and Feasibility Study of two CERCLA sites.	ER support contractor - Golder Associates, SWMU description/research
David Dander, INC-9	BS Environmental Sciences/ Applied Geology, Northern Arizona University	Work plan preparation, technical illustration
Crystal H. Furland, INC-9	BS Environmental Science/Geology * 2 years of experience in environmental studies.	Technical review

APPENDIX H

TA-2 and TA-41 OPERABLE UNIT WORK PLAN CONTRIBUTORS: EDUCATION AND RELEVANT EXPERIENCE

I. ADMINISTRATIVE MANAGEMENT AND TECHNICAL CONTRIBUTORS

NAME AND AFFILIATION	EDUCATION/EXPERTISE	ER PROGRAM ASSIGNMENT
P. A. Longmire, INC-9	Ph.D. Aqueous Geochemistry * 17 years combined experience in field hydrogeochemistry, soil chemistry regulatory oversight (NMEID), UMTRA project, and RCRA/CERCLA remediation (R.F. Weston). Principal Instructor for Ground Water Geochemistry and Geochemical Modeling courses for American Assoc. of Ground Water Scientists and Engineers. Numerous publications in peer-reviewed journals. Frameworks Studies principal investigator for geochemistry.	Project Leader for TA-2 and TA-41/Operable Unit Preparation of all chapters in work plan. Coordination of all aspects of work plan preparation and technical oversight.
C. J. Chisholm-Brause	INC-9 Ph.D. Aqueous and Surface Geochemistry * 5 years experience in geology, geochemistry, and water resources. Numerous peer-reviewed publications	Deputy Project Leader OU 1098
P. Gary Eller, INC-9	Ph.D. Inorganic Chemistry * 19 years experience in actinide and environmental chemistry research, process development and line/RCRA project management. Over 100 publications in peer-reviewed journals. Member of national/international committees in actinide chemistry.	Actinide and Fission Product Chemistry
Tracy Glatzmaier, EES-5	B.S. Chemical Engineering M.S. Industrial Engineering (Engineering Management Option) * 7 years experience in engineering and project design and management; data acquisition and analysis atmospheric transport and diffusion; * 4 years experience in management.	Programmatic Project Leader

Brad Wilcox, ES-15	Ph.D. in Watershed Management * 10 years experience in Hydrology/ Natural Resource Management waste site characterization experience. Adjunct Professor, University New Mexico. Author of books and publications on plant and fire ecology	Hydrologist
W. C. Francis, Consultant	* Graduate of Kansas City Jr. College. Civil/mechanical engineering courses at University of Kansas and University of New Mexico. Forty years experience in field engineering and surveying, and 35 years LANL supervisory experience. Extensive knowledge of maintenance/construction at virtually all Laboratory technical areas.	Technical review archival research
Jamie N. Gardner, EES-1	Ph.D. Geology * 16 years experience as a petrologist and structural geologist on petrologic and geothermal problems in a variety of young volcanic systems all over the western United States and Central America. Framework Studies technical team leader for the ER program.	Geology
Doris Garvey, EM-8	M.S. Economics * 7 years experience in Laboratory NEPA programs and management experience in compliance and CEARP activities.	NEPA
Beverly Larson, EM-8	M.A. Anthropology, Ph.D. Candidate in Anthropology * 17 years field experience, including 6 years as Laboratory archaeologist. Adjunct processor, University of New Mexico.	NEPA cultural evaluation
T. L. Morgan, INC-9	M.S. Engineering Geology * 16 years experience in hydrology field studies, regulatory oversight (NMED), NURE project and plutonium process chemistry. Currently QA leader for INC division activities in the Yucca Mountain Project.	QA, HS&E, hydrology

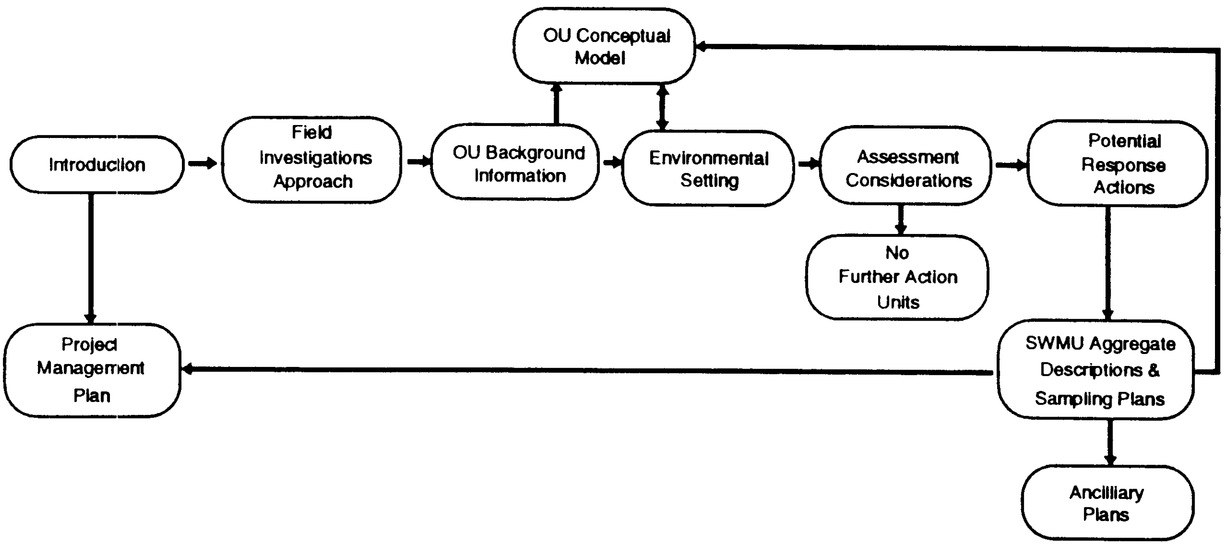
Larry Dziuk, ERM/Golder	Ph. D Toxicology *20 years of experience in human and ecological toxicology, multimedia risk assessment, hazardous waste site investigation, and site health and safety.	ER support contractor-ERM Program Management; technical coordinator
T. S. Foxx, EM-8	M.S. Biology * 18 years field ecology and waste site characterization experience. Adjunct Professor, University of New Mexico Author of books and publications on plant and fire ecology.	NEPA biological evaluation
Bruce Gallaher, ERM-8	MS Hydrology *15 years experience in waste management in contaminant hydrology	Principal Investigator for Hydrology within the ER Program
Anthony Gallegos, ASI, Inc.	Ph.D. Radiology and Radiation Biology *(Radioecology) 25 years of experience including extensive research on environmental transport of radionuclides and development of a model to simulate biomass and nutrient uptake dynamics in various climatic regimes.	ER support contractor-ASI, Inc.; ecological transport
Valerie Rhodes, ERM/Golder	M.S. Mineral Engineering *3 years of experience in environmental and geotechnical engineering and consulting, field assessment and laboratory and analysis.	ER support: contractor - ERM Program Management; SWMU description/research
Brent F. Russell, ERM/Golder	M.S. Environmental Sciences *14 years of experience in preparing technical work plans and quality assurance project plans, implementing site characterization activities, and designing drilling and sampling plans.	ER support contractor - Golder Associates; surface and subsurface water transport
Tami Wiggins, ERM/Golder	M.S. Applied Geography (Environmental Studies) *8 years of experience in researching, writing, and editing environmental assess-ments, biological surveys, transportation studies, and geographical articles.	ER support contractor - ERM Program Management; technical research and editing

R. A. Penneman, Consultant	Ph.D. Inorganic Chemistry, Sc.D.(h.c.) * 50 years experience in actinide chemistry and radiation chemistry. Extensive group and management experience at LANL. Over 150 publications in peer-reviewed journals. Member of national/international committees on actinide chemistry.	Technical review, archival research
Aimee Partain, INC-DO	* Sophomore in Environmental Engineering, New Mexico Tech.	Work plan preparation, technical review

III. ADMINISTRATIVE SUPPORT

NAME AND AFFILIATION	EDUCATION/EXPERIENCE	TA-2 and TA-41 OU ASSIGNMENT
Beverly Dickinson, INC-9	* 21 years office management and 10 years word processing.	Coordination, work plan preparation
Yvonne Herring, INC-9	* 9 years office experience and word processing.	Work plan preparation
Bruce Fretwell, INC-9	BA Quantitative Economics and Decision Sciences University of California at San Diego	Work plan preparation
Angie Partain, INC-DO	* Senior Los Alamos High School	Work plan preparation

APPENDIX I



National Environmental Policy Act and Related Documents

BIOLOGICAL SUMMARY
TA-2 AND TA-41
OPERABLE UNIT 1098

1.0 INTRODUCTION AND FURTHER INFORMATION

During 1992, Level I field surveys were conducted by the Biological Resource Evaluations Team (BRET) of the Environmental Protection Group (EM-8) for Operable Unit (OU) 1098, Technical Areas-2 and -41. Site characterization requires surface and subsurface sampling within the technical areas and Los Alamos Canyon. Further information concerning the biological field surveys or OU 1098 is contained in the full report "Biological Assessment for Environmental Restoration Program, Operable Unit 1098." The biological assessment will contain specific information on survey methods, results, and mitigation measures. This assessment will also contain information that may aid in defining ecological pathways and vegetation restoration.

2.0 LAWS

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

3.0 METHODOLOGY

The purpose of the surveys was threefold: (1) to determine the presence or absence of critical habitat for any State or Federal sensitive, threatened, or endangered plant or animal species within the OU boundaries; (2) to identify the presence or absence of any sensitive areas such as floodplains and wetlands that may be present within the areas to be sampled and the extent of these areas and their general characteristics; and (3) to provide additional plant and wildlife data concerning the habitat types within the OU.

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

Personnel of the OU propose to collect sediment samples and surface and subsurface samples. Soil samples will be collected from surface and subsurface sites. Subsurface characterization will involve drilling holes up to or exceeding 200 ft in depth. In some locations, trenching may be necessary.

EM-8 maintains a database that contains habitat requirements for all State and Federally listed threatened or endangered plant and animal species known to occur within the boundaries of Los Alamos National Laboratory and surrounding

APPENDIX I
NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) AND RELATED DOCUMENTS

The NEPA evaluation and document preparation for OU 1098 is an ongoing process. Updates to this section will be made as documents become available.

The status OU 1098 NEPA work as of May 24, 1993, is as follows:

Descriptive Title	Status of Document
• NEPA	
DOE Environmental Checklist (DEC)	LANL Internal Review
• Cultural Resources	
Initial Survey Summary	In progress
Final Report	In progress
• Biological Resources	
Initial Survey Report	Completed
Final Report	Completed and under review

5.0 RESULTS AND MITIGATION

5.1 Threatened, Endangered, and Sensitive Species

As a result of a habitat evaluation and previous data obtained for OU 1098, five species have been located within the area or have potential for occurrence there. These species are the spotted bat, the meadow jumping mouse, the Jemez Mountains salamander, the Western wood lily, and various raptorial birds. BRET should be contacted before any soil sampling is conducted that could disturb or disrupt these species.

The spotted bat is found in pinon-juniper, ponderosa, mixed conifer, and riparian habitats. Two critical requirements for the spotted bat are a source of water and roost sites (caves in cliffs or rock crevices). In Los Alamos Canyon, appropriate roost sites were plentiful; however, water appeared to be somewhat limited. In April of 1991, a portion of the cliff face (an area with small caves and rock crevices) of Los Alamos Canyon was searched for any physical evidence of use by the bats. No evidence was found. The same area of Los Alamos Canyon was then carefully explored for any suitable water, which is defined as small ponds or pools of slow-moving water. A few marginal watering areas were found. Mist-netting for bats in Los Alamos Canyon was conducted during July of 1992. No spotted bats were captured, and none have been found in similar attempts at TA-16, TA-36, and Bandelier National Monument. No adverse impact will occur to the spotted bat (if present) as long as small caves and rock crevices are not disturbed and the water sources within the canyon are not altered.

The Jemez Mountains salamander is found primarily in spruce-fir and mixed conifer habitats between 7225 and 9250 ft elevation. Its habitat requirements are very specific: talus slopes and decaying logs which the animal utilizes as temporary refuges. In Los Alamos Canyon, the steep canyons provide the necessary habitat requirements for the Jemez Mountains salamander. Specimens have previously been observed or collected in upper Los Alamos Canyon by S. R. Williams (August 1974 at the junction of the upper fork), D. A. Guthrie (summer 1978 near the headwaters of Los Alamos Creek), C. M. Bogert (June 1979 above the reservoir), and C. A. Ramotnik (May and June 1985 near Camp May). In May of 1985, C. A. Ramotnik found one Jemez Mountains salamander in the middle section of the canyon, approximately 1 mile east of the Diamond Drive bridge overpass (SE 1/4 Sec16 T19 NR6E) and approximately at the western edge of TA-41. This site represents one of the lowest elevation habitation sites documented for the Jemez Mountains salamander. Mitigation measures for protection of this amphibian include allowing fallen logs to remain in place and limiting slope disturbances, especially on north-facing aspects. In addition, vegetation on slopes which could provide cover to the salamanders should not be cleared.

The meadow jumping mouse prefers habitat containing permanent streams, moderate to high soil moisture, and dense and diverse streamside vegetation consisting of grasses, sedges, and forbs. Due to its long hibernation period, the meadow jumping mouse is primarily active from June–September in the Jemez Mountains. In 1992, small mammal trapping sessions within Los Alamos Canyon captured no meadow jumping mice. However, this area may support a small population, and further trapping is required to verify their presence or areas. After searching this database, a habitat evaluation survey (Level II) was conducted nearby. A Level II survey is performed when areas are present that are not highly disturbed and could potentially support threatened and/or endangered species. Techniques used in a Level II survey are designed to gather data on the percentage of cover, density, and frequency of both the understory and overstory components of the plant community.

The habitat information gathered through the field surveys was then compared with the habitat requirements for species of concern as identified in the database search. If habitat requirements were not met, then no further surveys were conducted and the site was considered cleared of any impact to State and Federally listed species. If habitat requirements were met, then specific surveys for the species of concern were conducted. The specific species surveys were done in accordance with preestablished survey protocols, which often required certain meteorological and/or seasonal conditions.

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

4.0 SPECIES IDENTIFIED

Database searches indicated that the species of concern for this OU were:

Peregrine Falcon, *Falco peregrinus*–Federal endangered

Bald Eagle, *Haliaeetus leucocephalus*–Federal endangered

Common Black-Hawk, *Buteogallus anthracinus*–State endangered

Mississippi Kite, *Ictinia mississippiensis*–State endangered

Broad-billed Hummingbird, *Cynanthus latirostris*–State endangered

Willow Flycatcher, *Empidonax trailii*–State endangered

Spotted bat, *Euderma maculatum*–State endangered

Meadow jumping mouse, *Zapus hudsonius*–State endangered and Federal Candidate

Jemez Mountains salamander, *Plethodon neomexicanus*–State endangered and Federal Candidate

Say's pond snail, *Lymnaea captera*–State endangered

Wright's fishhook cactus, *Mammillaria wrightii*–State endangered

Santa Fe cholla, *Opuntia viridiflora*–State endangered

Grama grass cactus, *Toumeya papyracantha*–State endangered and Federal Candidate

Western wood lily, *Lilium philadelphicum* var. *andinum*–State endangered.

- Avoid disturbance to vegetation along canyon slopes especially in drainage areas.
- Avoid tree removal. If tree removal is required, contact BRET for evaluation.

In addition to these mitigation measures, BRET also requests notification of any activity that would disturb the vegetation before that activity is actually conducted.

The "Biological Assessment for the Environmental Restoration Program, Operable Unit 1098" 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. However, BRET will be notified if additional mitigation measures are required.